

# INSTRUMENTATION AWARDS

1987 and 1988

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UNDERGRADUATE, SCIENCE, ENGINEERING,  
AND MATHEMATICS EDUCATION  
Directorate for Science and Engineering Education  
Washington, D. C. 20550



NATIONAL SCIENCE FOUNDATION

NF 97-033528

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Catalog of Federal Domestic Assistance Number 47.071  
College Science Instrumentation



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For general inquiries about Undergraduate Science, Engineering and Mathematics  
Education, please call—(202) 357-7051

## Foreword

The National Science Foundation Directorate for Science and Engineering Education was established in October of 1983 and is responsible for providing national leadership, useful examples, and support for enhancing the quality of education in science, mathematics, and engineering at all levels. Among the directorate's major long-range goals are its efforts to ensure that the best possible professional education in science, mathematics, and engineering is provided in the Nation's colleges and universities, and also that college-level opportunities are available to broaden the science backgrounds of non-specialists.

The College Science Instrumentation Program (CSIP), established in 1985, and the Instrumentation and Laboratory Improvement Program, established in 1987, serve these two goals by supporting laboratory curricular improvements based on instrumentation. Projects are selected for their promise both to provide local strengthening and to serve as models for other undergraduate laboratory programs. The enormous interest in this program and its success reflect a great national need and underscore NSF's important leadership role at the undergraduate level.

The report of the National Science Board on Undergraduate Science, Mathematics, and Engineering Education (NSB-86-100)<sup>1</sup> calls for an expanded role for NSF at the undergraduate level. An expansion of undergraduate support activities occurred in 1988. These expanded activities include instrumentation support available to all two and four year colleges and universities, faculty enhancement, calculus and engineering curriculum development, and career access for women, minorities and the disabled.

We are proud of the quality of the grants described in this book. We hope this book will be of use and interest to science, mathematics and engineering faculty at all U.S. colleges and universities. In due time, we trust that a broader set of NSF activities will be in place to help enhance the quality of undergraduate education in science, mathematics and engineering across the country.

Bassam Z. Shakhshiri  
NSF Assistant Director  
for Science and Engineering Education

January 1, 1990

<sup>1</sup>Copies may be obtained from the Division of Undergraduate Science, Engineering and Mathematics Education, National Science Foundation.

# INTRODUCTION

## PROGRAM DESCRIPTION

Undergraduate instruction is a vital element in the preparation of our Nation's future scientists and engineers, teachers, leaders in business and government, and technically literate citizens. Students in undergraduate science, engineering and mathematics courses majors and non-majors alike must have a laboratory and/or field experience with suitable, up-to-date equipment in order to become involved in the work that is at the heart of scientific progress and understanding.

This publication describes the projects initiated during FY 1987 and FY 1988, the third and fourth years of the undergraduate instrumentation programs. The principal purpose of this document is to stimulate interest in and disseminate information about recent activities which improve undergraduate science, mathematics and engineering instruction. It is expected that the information provided will be useful to college faculty, administrators, and others concerned with undergraduate education.

In FY 1988 the College Science Instrumentation Program (CSIP) became a part of the Instrumentation and Laboratory Improvement program (ILI). ILI expands upon the College Science Instrumentation Program budgeted in the Science and Engineering Directorate (SEE), with additional support budgeted through the research directorates which supports doctoral university instrumentation. ILI broadens institutional eligibility to include universities and two-year colleges and increases the maximum amount of funds that may be requested in a proposal.

Specifically, CSIP supports awards to two-year and four-year institutions; the doctoral university instrumentation part of ILI is supported by the NSF disciplinary research areas.

The goal of NSF's Instrumentation and Laboratory Improvement program is to improve the quality of the undergraduate curriculum by supporting projects to develop new or improved instrument-based undergraduate laboratory and/or field courses in science, mathematics, or engineering. ILI provides matching support for the instrumentation necessary to implement undergraduate instructional improvements at U.S. two-year and four year colleges and universities.

ILI proposals are evaluated and funded collaboratively by NSF's education and research directorates. In this way, ILI is fully integrated into the ongoing research and education activities of the Foundation.

The specific objectives of ILI are to encourage and support the:

- Introduction of modern instruments to improve the education of undergraduate students in science, mathe-

tics and engineering courses, laboratories, and field work;

- Interfacing of computers with scientific instrumentation and other appropriate uses of current technology in science, mathematics and engineering instruction;
- Development of new ways for using instrumentation to extend instructional capabilities; and
- Establishment of equipment-sharing capability via consortia or centers.

The strategy underlying the highly competitive nature of the Instrumentation and Laboratory Improvement program is to produce projects that will:

- Set standards for instrumentation and its instructional use against which other institutions can measure their own performance: standards which they will strive to equal or exceed;
- Yield products such as laboratory manuals, scholarly publications, etc., thus serving a common good as well as bringing local improvement.

The program supports well-focussed projects which will result in clear improvement in the quality of undergraduate education. This may be done by providing for:

- Acquisition of new state-of-the-art instructional scientific equipment;
- Upgrading obsolete or unreliable equipment with current models that significantly improve instructional capabilities.

Because the objective of the program is to improve the quality of instruction, projects based primarily on financial need or increased enrollments are not appropriate. Projects are expected to involve activities which go well beyond the basic level of support that the institution itself must provide in order to maintain a viable teaching program. Activities supported by ILI include the improvement of formal laboratory courses associated with undergraduate instruction, the enhancement of undergraduate student research, projects aimed at acquainting non-science majors with principles and methods of science and engineering, and projects concerned with improving undergraduate science education of prospective teachers. The foundation is also concerned about the underrepresentation of women, minorities, and handicapped persons in careers in mathematics, science and engineering, and supports projects whose target audiences are students in these groups. The reader is referred to Sections VI through VIII for lists of projects targeting women, minorities, handicapped students, and

prospective teachers, and projects having substantial undergraduate research components.

ILI seeks proposals that request funds for instructional scientific equipment. A maximum of \$100,000 may be requested from NSF; grantee institutions must provide an equal or greater matching contribution. The minimum grant request to ILI is \$5,000 in NSF funds.

Grants in support of ILI activities routinely are made for a period of 30 months. It is expected that the requested equipment will be acquired during this time.

Presentation of the results of successful projects at professional meetings or in appropriate journals is highly encouraged in order that institutions other than the grantees also may benefit from ILI projects.

Although the categories of awards just described are expected to include the majority of projects supported through ILI, additional ideas and mechanisms will be considered by NSF.

A common feature found among proposals and awards across all the disciplines was the instructional use of computers. About 60% of the CSIP/ILI-supported projects included computer based activities, especially (a) interfacing microcomputers with scientific equipment for computer-controlled instrument operation and data acquisition, and (b) analysis of experimental data.

#### Characteristics of FY 1987 CSIP and FY 1988 ILI/CSIP Proposals and Awards

In the FY 1987 competition 970 proposals were received from 43 states, the District of Columbia, Puerto Rico, and the Virgin Islands, requesting 26 million from NSF. Following peer review, 337 awards were made totalling more than 8.5 million dollars from NSF. Projects were supported in 43 states, the District of Columbia, Puerto Rico and the Virgin Islands.

The distribution of FY 1987 CSIP-funded projects (see Table I) was similar to that of the projects supported in 1985 and 1986 by discipline, by geography, by size and type of institution, and by the inclusion of computer-related activities.

In the FY 1988 competition, 1,311 proposals were received, requesting almost \$45 million dollars. Following peer review, 363 awards were made, totalling almost \$11 million dollars, to 261 non-doctoral institutions in 43 states and Puerto Rico. For the first time, two-year and community colleges were included in the instrumentation program

**Table I. CSIP Awards by Discipline**

|                       | FY 1987      |                |
|-----------------------|--------------|----------------|
|                       | #<br>Awarded | \$K<br>Awarded |
| Biological Science    | 73           | 1,748          |
| Chemistry             | 81           | 1,957          |
| Computer Science      | 21           | 807            |
| Earth Science         | 10           | 372            |
| Engineering           | 57           | 1,788          |
| Interdisciplinary     | 21           | 590            |
| Mathematics           | 5            | 193            |
| Physics               | 35           | 546            |
| Psychology            | 24           | 328            |
| Other Social Sciences | 10           | 200            |
| Total                 | 337          | 8,550          |
| Overall Success Rate  | 34%          | 32%            |

and they received more than \$1.2 million dollars for 39 awards.

The distribution of the FY 1988 ILI/CSIP-funded projects is shown in Table II.

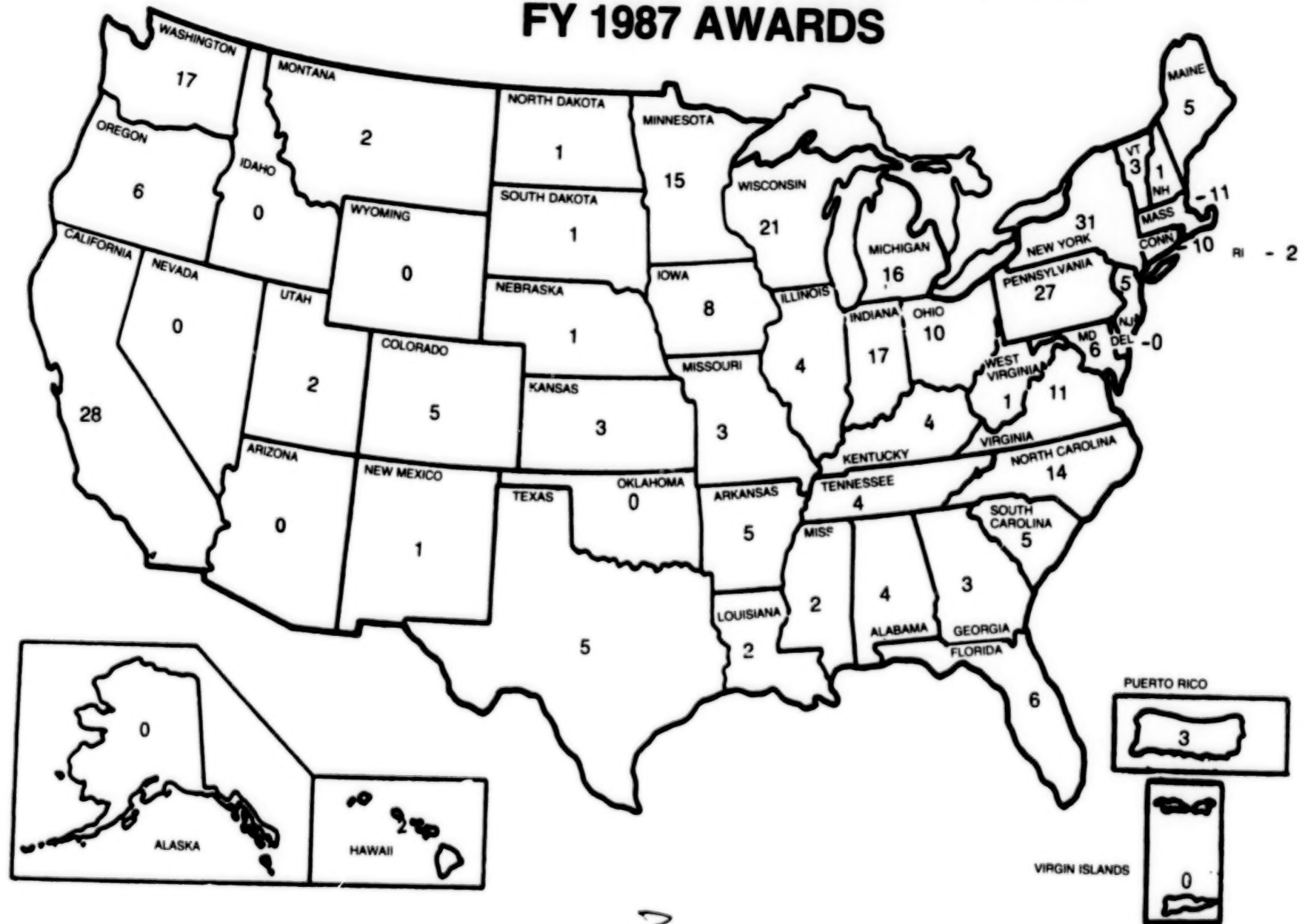
For further information about the Instrumentation and Laboratory Improvement program, please contact:

Undergraduate Science, Engineering,  
and Mathematics Education  
Room 639  
National Science Foundation  
1800 G Street, N.W.  
Washington, D.C. 20550  
(202) 357-7051

**Table II. ILI Awards by Discipline**

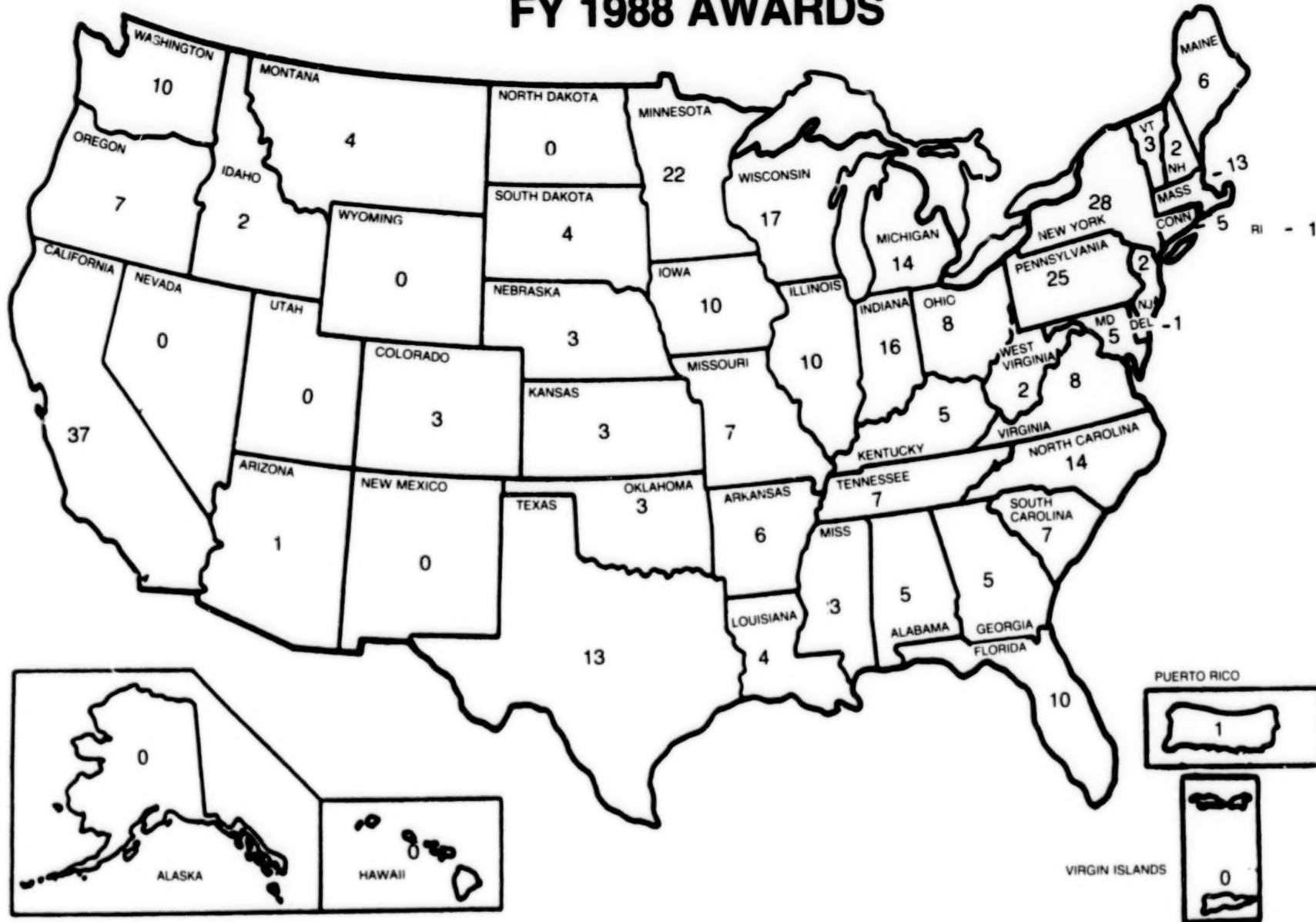
|                               | FY 1988      |                |
|-------------------------------|--------------|----------------|
|                               | #<br>Awarded | \$K<br>Awarded |
| Biological Science            | 70           | 1,769          |
| Chemistry                     | 90           | 2,394          |
| Computer Science              | 28           | 1,104          |
| Earth Science                 | 18           | 463            |
| Engineering                   | 65           | 2,509          |
| Inter- and Multidisciplinary  | 17           | 722            |
| Mathematics                   | 18           | 645            |
| Physics                       | 38           | 839            |
| Psychology and Social Science | 19           | 427            |
| Total                         | 363          | 10,872         |
| Overall Success Rate          | 28%          | 24%            |

# COLLEGE SCIENCE INSTRUMENTATION FY 1987 AWARDS





# ILI / CSIP FY 1988 AWARDS





## I. PROJECT DESCRIPTIONS: FY 1987 AWARDS

Indicated for each project are the project director's name, and institution, the grant number, and the dollar amount of the NSF award.

### BIOLOGY

Leo Pezzementi  
Birmingham Southern College  
Birmingham, AL

CSI 8750089  
\$22,046

#### **"Equipment for a Modern Undergraduate Cell Biology Laboratory"**

In this project, students will be introduced to some of the instruments, techniques, and concepts of modern Cellular and Molecular Biology through a series of experiments performed with primary cultures of skeletal muscle cells prepared from chick embryos. The new equipment provided through this project consists of a biological safety cabinet and controlled-atmosphere incubator for the preparation, maintenance, and incubation of cell cultures of skeletal muscle (a cell type that differentiates in vitro and lends itself to a variety of cell biology experiments), an ultra-low-temperature freezer for the storage of perishable materials needed for cell culture, a liquid scintillation counter, micro-computer and associated software for the quantification, analysis, and presentation of the results of radiobiological experiments designed to investigate the rates of synthesis, degradation, transport, and secretion of muscle proteins, and three gel electrophoresis units for the determination of the molecular weight and identity of muscle-specific proteins.

These experiments will allow students to use a variety of techniques from modern Cellular and Molecular Biology to explore some of the fundamental properties of living cells.

Joyce K. Ono  
California State Univ.—Fullerton  
Fullerton, CA

CSI 8750586  
\$43,082

#### **"Equipment for Neurobiological Experiments and Computerized Data Acquisition/Analysis in an Undergraduate Physiology Program"**

During the past 10 years, Neuroscience has coalesced from Pharmacology, Physiology and Biopsychology into a coherent discipline which occupies a prominent position in Biology. This project integrates neurobiological exper-

iments into current physiology courses through the purchase of extracellular recording devices which can be used to add two modern, sophisticated neurobiology experiments to the Mammalian Physiology laboratory and to initiate the laboratory portion of a new Neurobiology course.

Computer-interfaced data acquisition and analysis apparatus is being used with the above units and in 11 of 13 existing experiments in Mammalian Physiology, as well as in various experiments in Neurobiology, Cell Physiology and Comparative Physiology. The addition of these two experimental setups and the experiments they make possible enable students to become familiar with some of the modern, sophisticated neurobiological and computer-oriented techniques used in research and industrial laboratories where graduates may pursue advanced studies or career employment.

Christopher L. Kitting  
California State University Hayward  
Hayward, CA

CSI 8750588  
\$13,422

#### **"Portable Equipment for Teaching Undergraduate Biology Students to Conduct Digital Video Analyses along Environmental Gradients"**

A transportable image analysis computer system is being used for the objective acquisition, analysis, and presentation of diverse imagery data collected in the field and laboratory. The primary goal in the extensive undergraduate field projects supported through this award are to illustrate limitations on population distributions; students thus uncover major limits at opposite boundaries in zonation along environmental gradients. Nearby marshes on San Francisco Bay provide gradients between marine, aquatic, and terrestrial environments, both natural and disturbed.

One such set of quantitative experimental field ecology studies is providing students with valuable insights into field experimentation through high-resolution, time-lapse monitoring of transplant experiments. Students are comparing the fates of plants (and of sedentary animals) that have been moved experimentally beyond their normal zones, with the fates of replaced individuals. These studies strikingly illustrate the selection pressures that operate when

an organism attempts to invade a new habitat. Such modern field experimental approaches are preparing students to make practical, technical, and logical applications of science in their personal lives and, for some, in environmental careers.

Sandra B. Sharp  
California State Univ Los Angeles  
Los Angeles, CA

CSI 8750387  
\$49,421

#### **"Gene Manipulation: A Practical Undergraduate Education in the Theory, Methods, and Potential of Biotechnology"**

With the equipment (centrifuges, incubation equipment, specialized storage apparatus, a DNA photodocumentation system, water purification equipment and electrophoresis apparatus) secured through this project, this Biology Department is expanding its course offerings in Molecular Biology to include a core of four courses to deal with biotechnology at various levels. Two of these provide intensive experience with practical genetic manipulation procedures in a student genetic engineering laboratory.

Recent advances in the technology of gene manipulation have created a booming new industry, an extraordinarily powerful research tool, and promises for novel solutions to medical, environmental, and agricultural/industrial problems. A broad spectrum of undergraduates have a need for education in the new molecular biology. Those who plan to continue in research-oriented higher degree programs will profit greatly from having practical knowledge and laboratory skills that will equip them to apply modern molecular genetic approaches to research problems. Students terminating their formal education at the B.S. level can be immediately employable in the biotechnology industry or in one of the many research laboratories employing techniques of gene manipulation. Pre-professional students can be prepared better to understand and appreciate diagnostic and therapeutic techniques stemming from the new biotechnology and to appreciate its potential for the future practice of medicine.

Richard S. Lewis  
Pomona College  
Claremont, CA

CSI 8750744  
\$6,205

#### **"Laboratory Equipment to Improve Undergraduate Instruction in Physiological Psychology"**

This project will provide laboratory equipment to improve undergraduate instruction in the physiological processes involved in human cognition. The equipment purchased would present, record and analyze event-related

potentials (ERP). Students taking courses in the physiological basis of behavior will learn the fundamental principles involved in ERPs, gain experience in its operation in a variety of experiments investigating the relationship between physiology and cognition, and will learn experimental applications of this technique.

Alfred W. Hanson  
Whittier College  
Whittier, CA

CSI 8750389  
\$11,833

#### **"Microcomputer-Assisted Laboratory Stations for Undergraduate Physiology Courses"**

Five highly versatile microcomputer assisted laboratory stations are being used in nine different courses within three academic departments to modernize undergraduate instruction in physiology. The instrumentation includes Apple II GS microcomputers, Apple Imagewriter II printers, Harvard/SRI simulators, and six different physiological data acquisition systems for each station. Stations thus equipped collect, display and print the data from a variety of physiological experiments including those in spirometry, cardiography, muscle contraction, reflex function, skin responses, and biofeedback. The use of these microcomputer-aided instruments permits a wide range of laboratory activities at approximately 60% of the cost of traditional recording devices. In addition, relatively inexpensive programs can be added for simulations and autotutorials dealing with such specific processes as intermediary metabolism, cardiovascular fitness, nutrition and renal function. The completed stations are providing the students with a unique opportunity to further their understanding of the methods of obtaining experimental data. It also allows them to develop skills involved in the analysis and interpretation of such data. Finally, it exposes them to wide variety of experiences at a reasonable cost.

John F. Nolte  
Regis College  
Denver, CO

CSI 8750958  
\$50,000

#### **"Laboratory Equipment to Initiate an Integrated Junior-year Course in Investigative Biology"**

The project is providing Junior-level Biology majors with basic training in the design, execution and evaluation of scientific research in a two-semester course entitled Investigative Biology. The first semester includes discussions of general principles and the performance of sample experiments from a variety of biological areas using oscilloscopes and other equipment for relatively simple investigations. The second semester consists of the design

and performance of a research project from the area of photoreceptor physiology, using some model experiments with the electronic probes, amplifiers, analysis/recording devices and computers to process the data. The students are studying the physiological effects of the timing, intensity and wavelength of light on several types of photoreceptors.

Lisa M. Baird  
Connecticut College  
New London, CT

CSI 8750877  
\$50,000

#### **"Improving Electron Microscopic Study in the Undergraduate Curriculum"**

This project has provided matching funds to purchase a combined transmission and scanning electron microscope (TEM/SEM) to provide enhanced opportunities for students to study and experiment at the cellular level. Central to this development is a course in The Theory and Techniques of Electron Microscopy, designed to familiarize students with the principles of TEM and SEM design and operation. Through intensive laboratory instruction, students gain "hands-on" experience in TEM and SEM techniques and operation which then is applied to selected research projects. The new TEM/SEM enriches laboratory exercises at all levels of the biology program by focusing attention on the cellular aspects of organismal structure, and provides new opportunities for student independent and honors research in Biology.

R. E. Gaensslen  
University of New Haven  
West Haven, CT

CSI 8750754  
\$15,086

#### **"Biochemical Equipment for an Undergraduate Forensic Science Laboratory in Blood/Body Fluid Identification and Individualization"**

Forensic scientists require methods and procedures for identifying and typing the human blood and body fluids encountered in cases of homicide, assault, robbery, sexual assault and other crimes against persons. The Enzyme-Linked Immunosorbent Assay (ELISA) technique offers a desirable alternative to present procedures. Its major advantages are increased sensitivity, ability to utilize recently developed, highly specific monoclonal antibodies in its tests, and the ability to introduce new levels of quantitation and instrumental objectivity in interpreting test results. Modern ELISA instrumentation, its use and applications are revolutionizing forensic tests on blood, body fluids and stains.

In addition, the isoelectric focusing (IEF) technique offers many advantages over earlier electrophoretic proce-

dures for typing blood and body fluid stains. Its advantages include the ability to recognize more genetic types in several systems and thus to improve individualization of stains left by biological materials. The application of IEF to the genetic typing of blood and body fluid stains increases the capabilities of forensic scientists, enabling them to provide more and better evidence to the justice system they serve. Through the help of this grant, future forensic specialists in this model program are being trained on state-of-the-art apparatus. This project constitutes a striking example of science serving society in helping to demonstrate the guilt or innocence of persons accused of violent crimes.

Paul J. Cunningham  
Gallaudet University  
Washington, DC

CSI 8750493  
\$24,571

#### **"Equipment for Teaching Field, Survey, and Analysis Techniques in Environmental Biology to Undergraduates"**

A new course "Field, Survey, and Analysis Techniques in Environmental Biology" is being developed. This new course is introducing the students to new concepts and techniques in ways designed to stimulate interest in investigative studies and in research projects. Using the equipment procured through this award, Biology majors are gaining experience in the description and analysis of ecological systems, as well as in hypothesis structuring, field sampling, literature retrieval and use, descriptive and analytical statistical techniques, field surveys and experimental design methods.

Methods and techniques involved in field studies of aquatic and terrestrial habitats are being introduced through studies of aquatic and terrestrial components of the Anacostia and Potomac Rivers and the Chesapeake Bay. Students are becoming better prepared for future graduate or lab/research positions by using the newly available fluorescent and phase microscopes, fluorometer, ion analyzer, spectrophotometer, sieve shaker, incubator, colony counter, furnace, and BOD and pH meters. Like all other parts of the Gallaudet curriculum, this program is designed especially to meet the needs of students with severely impaired hearing.

Stephen Klemann  
Rollins College  
Winter Park, FL

CSI 8750272  
\$12,700

#### **"A Liquid Scintillation Counter to Improve Undergraduate Instruction in Cellular and Subcellular Biology"**

Recent developments in technology now enable biologists to study organisms at the cellular and subcellular lev-



els. This new field of Molecular Biology promises to answer many previously unanswered questions about, e.g., regulation physiology, and the development of organisms. Use of radioactive isotopes for the labeling and tracing of molecules has proved invaluable in Molecular Biology—a technique which requires the new liquid scintillation counter provided through this award.

Actual experience with radioactive labeling and scintillation counting is helping the students better understand new concepts and developments in Biology. By incorporating labeling experiments into the study of plants, animals and bacteria, the universality of cells is being stressed, thus demonstrating how modern techniques may be applicable to diverse sets of organisms and disciplines. Through this experience the students are receiving practical training in the use of modern biological instrumentation, and are improving their skills in understanding and solving biological problems.

Marion Furr  
Patrick Johnson  
Paine College  
Augusta, GA

CSI 8750881  
\$29,604

#### **"Computer-Controlled Instrumentation for the Improvement of Introductory Undergraduate Biology Laboratories"**

Computer-based laboratory control centers (each including a Macintosh microcomputer, a high resolution pH meter, controlled-temperature water bath, programmable stirrer/hot plate, spectrophotometer, compound microscope, electronic balance, and centrifuge) are facilitating the development of computer, analytical, statistical, and observational skills for students enrolled in the introductory Principles of Biology course. Competencies are being developed through a series of Biology projects requiring skills in monitoring, data collection, statistical analysis, modeling, and report generation.

With this new academic thrust, even lower division students are becoming better prepared to undertake undergraduate laboratory research, to complete major field projects, and eventually to participate successfully in graduate, medical, dental, and other professional programs.

Billy W. Geer  
Christina M. Schimandle  
Knox College  
Galesburg, IL

CSI 8750319  
\$14,658

#### **"Equipment for Undergraduate Biological Chemistry Laboratories for Teaching Gene Expression"**

Although the curriculum currently offers lecture courses in Biochemistry, Molecular Genetics, and Cell Physiology,

laboratory work is available only in Cell Physiology. Given the tremendous advances in research that are occurring in Biological Chemistry today, this situation leaves Biology and Chemistry majors relatively unprepared for advanced work (including undergraduate research projects) in these areas.

This project is remedying the situation by supplying equipment for a Gene Expression Laboratory course in the Biology Department, and for new laboratory exercises associated with the current Biochemistry course in the Chemistry Department. In the former course, students are learning methods for the study of proteins, RNA and DNA at the molecular level. In Biochemistry, a new series of experiments involving enzyme functions, lipid and carbohydrate analyses, and protein purification are being added to the lab. The collective experience of these courses are allowing students to more fully utilize their talents as they prepare for scientific careers.

Michael S. Maloney  
Butler University  
Indianapolis, IN

CSI 8750263  
\$25,775

#### **"Acquisition of Phase Contrast and Fluorescence Microscopes for Biology Education"**

A comprehensive internal program review and the resulting curriculum review suggested that undergraduate majors in this Department needed more practical exposure to light microscopy and its attendant techniques. Through this project, the Department is purchasing sixteen student phase-contrast microscopes and three fluorescence microscopes for use primarily in the Cell Biology, Microbiology, Immunology and Invertebrate Biology laboratories. A TV camera, video recorder and TV monitor also are being used with one of the phase-contrast microscopes to enhance the study of living cells in introductory courses for majors and non-majors. The use of living cells in portions of these courses, the new phase-contrast capability, and the means for showing preparations to the whole class, are adding significantly to the interest of students in these courses.

William H. Harvey  
Earlham College  
Richmond, IN

CSI 8750217  
\$34,544

#### **"Equipment to Expand Undergraduate Instruction in Cellular and Molecular Biology"**

The Biology Department is involved in a four-phase program to expand the instrumentation of its Cellular and Molecular Biology laboratories. Phase one was completed by the institution; this project is covering the second phase

which involves procurement of an ultracentrifuge, electrophoresis equipment, photographic equipment, a uv/visible spectrophotometer, a CO<sub>2</sub> incubator, and an ion-free reagent water system. This equipment enables undergraduates to perform expanded laboratory experiments and individual projects in cell fractionation; protein, DNA and RNA separations; transfers of proteins and nucleic acids for testing and analysis (Southern, Northern, and Western blots); quantitative determination of proteins and nucleic acids; autoradiography; DNA sequencing; restriction digests of nucleic acids; and cloning of restriction fragments.

A new course in Molecular Genetics is being offered, while major laboratory segments of Advanced Cell Biology and Developmental Biology are being expanded. Substantial laboratory exercises also are being added to coursework in Microbiology, Genetics, Biochemistry, and Immunology. Students are gaining vastly expanded experience with current techniques and equipment used in Protein and Nucleic Acid Biochemistry and Molecular Genetics.

James S. Miller  
Goshen College  
Goshen, IN

CSI 8750690  
\$16,108

#### **"Equipment for Computer Interfacing in Undergraduate Physiology Laboratories"**

New laboratory experiences for undergraduates in three Biology courses which have a substantial Physiology component (Human Anatomy and Physiology, Principles of Biology, and The Biological World) are being developed using new equipment acquired through this grant. The project has three major foci: teaching students how to interface computers with laboratory equipment, how to use computers to acquire data, and how to manipulate and analyze data with computer assistance. This equipment makes it possible to consider aspects of cardiovascular physiology, respiratory physiology, and the physiology of reflexes that previously could not be addressed in these courses because the requisite equipment was lacking.

Laboratory experiments in other areas also are being upgraded by involving students more directly. Laboratories being improved in this way include the EKG labs; lung physiology labs; exercise physiology labs; and labs in biochemistry and human genetics (where computer simulations are being used extensively). A laboratory manual is being prepared that reflects the hands-on experiences of this P.I. and his students.

David M. Sever  
St Mary's College  
Notre Dame, IN

CSI 8750005  
\$49,825

#### **"Electron Microscopy in the Undergraduate Biology Curriculum"**

This project provides an Hitachi Model H-300 Transmission Electron Microscope with a Scanning attachment and the ancillary preparative equipment needed to install a new electron microscopy facility in space provided through new construction. The curricular improvements that result have been based on an extensive review of facilities, equipment and curriculum that firmly established the need for an electron microscope to make possible more sophisticated student work in both introductory and advanced courses—including Biology and Human Values, Concepts of Biology, Plant Morphology, Anatomy of Vascular Plants, Parasitology, Physiology, Introduction to Research, and Independent Research Topics. The instrument's contribution to enhancing options for independent projects and required student research is of special significance. The departmental faculty is unusual in that five of its eight full-time members have had previous experience working with electron microscopy.

Ann Blakley  
Cornell College  
Mount Vernon, IA

CSI 8750306  
\$7,767

#### **"Scientific Equipment for Undergraduate Instruction in Animal Physiology and Behavior"**

In the area of Animal Physiology, fundamental research tools are a computer-recorder system and a storage oscilloscope for monitoring physiological functions and changes. In Animal Behavior and Ornithology a storage oscilloscope has become the standard tool for displaying and analyzing an array of animal vocalizations. In both areas there are many experiments that help to elucidate important concepts that cannot be done without these instruments. The purchases made possible through this grant are enlarging this Department's capacity to train undergraduates in these areas.

The importance of these additions stems from the fact that, over recent years, research in Physiology and Animal Behavior has become increasingly dependent on high-technology equipment. As usage of this type of equipment has become a matter of course in research laboratories, it has become essential for instructional purposes as well. Students must be introduced to equipment that is used routinely to gather data if they are to become familiar with and eventually to evaluate concepts developed as a result of that experimentation. Likewise, their potential as research scientists is enhanced by a working familiarity with the methodologies that are used widely in current research.



Betty J. Cole  
Thomas M. Wolf  
Washburn University of Topeka  
Topeka, KS

CSI 8750077  
\$27,607

**"An Ultracentrifuge and a Spectrophotometer for an Undergraduate Molecular Biology Laboratory"**

As many undergraduates are moving away from an interest in medicine and descriptive biology into the research and technical areas of Molecular Biology, it becomes increasingly important to expose them to basic methods of ultracentrifugation and spectrophotometric analysis. The Department is changing its curriculum to offer an emphasis in Microbiology and Molecular Biology to meet this change in student interest.

The new equipment (ultracentrifuge and UV/Vis/spectrophotometer) purchased through this award is being used for experiments in six different laboratories as well as in independent student research projects. This broadly based exposure is ensuring that the students have multiple chances to use and become familiar with this instrumentation and its uses.

Karan Kaul  
Kentucky State University  
Frankfort, KY

CSI 875055  
\$7,510

**"Equipment to Improve Undergraduate Instruction in Cellular and Developmental Biology"**

Use of the new computer-interfaced spectrographic equipment provided through this project is improving laboratory instruction in Developmental and Cellular Biology courses. The students in this historically Black institution are being exposed to current state-of-the-art equipment in laboratory studies of functional aspects of living systems.

Although the primary emphasis is on Cellular and Developmental Biology, instruction in Biochemistry, Human Physiology, Human Anatomy, and special projects also benefit greatly from the project. One of the most important elements of the project is its introduction of modern data collection and analysis techniques to the Department's curriculum.

David F. Oettinger  
Kentucky Wesleyan College  
Owensboro, KY

CSI 8750098  
\$15,143

**"Immunology—A New Capstone Course for Undergraduate Biology Majors"**

A new capstone course required of biology majors is being created. Immunology is replacing the course which

has served a capstone function for the past 22 years, Plant Physiology. Immunofluorescence, electrophoretic procedures, and cell culture-hybridoma production are becoming part of a revised Immunology laboratory curriculum. This revised curriculum is seeking to ensure that biology majors are knowledgeable and well-trained in the areas of experimental design; discipline in experimental work; care of living organisms; precision in manipulative work; use of instrumentation; data collection; data analysis; and report writing. Microscopes, protein electrophoresis and immunoductrophoresis equipment are being used by the students. Specifically, the immunology laboratory includes three new project areas in which students generate and test hypotheses: humoral immunity (producing antisera to soluble antigens, protein determinations, and electrophoretic/immunoelectrophoretic/immunodiffusion demonstrations of antibody specificity and titer), immunolabelling (producing antisera to bacterial antigens, purifying and labelling antibodies and subsequent demonstration of their specificity with immunofluorescence), and cellular immunity" (demonstrating populations of T- and B-lymphocytes, culture of mouse myeloma cells, fusion of myeloma cells with stimulated mouse splenic lymphocytes, and attempts to identify monoclonal antibody-producing cells).

Laura G. Malloy  
Bates College  
Lewiston, ME

CSI 8750377  
\$30,192

**"Equipment to Teach Microprocessor Analysis of Video and Analog Signals in an Undergraduate Physiology Laboratory"**

This project is improving the undergraduate program in experimental Physiology by introducing the use of video equipment and computer interface devices for data acquisition and analysis. Students are being exposed to three current methodologies: a video-image analysis system, an analog-digital converter system, and an x-y digitizing tablet. Microprocessors are being used to analyze the output from the three systems.

The equipment is making it possible to introduce strikingly new laboratory exercises that improve both the accuracy and efficiency of data acquisition and analysis, and that give undergraduates hands-on experience with highly current research and analytical skills. The project is impacting students in eleven courses and in independent student research covering three subdisciplines: Animal Physiology, Plant Physiology, and Physiological Psychology.

William L. Steinhart  
Bowdoin College  
Brunswick, ME

CSI 8750285  
\$50,000

**"A Scanning Electron Microscope for Undergraduate Biology Instruction and Student Research"**

Technical advances in the design and current applications of the Scanning Electron Microscope (SEM) are making it increasingly desirable for undergraduate Biology majors to gain experience in using it. The recent arrival of two new faculty members with expertise in SEM technology have made this a propitious time for the Department to develop two new courses, Electron Microscopy and Advanced Developmental Biology. Both of these use scanning electron microscopy as a primary technique. In addition, the SEM will be used for demonstrations in the Introductory Biology, Developmental Biology (core) and Botany courses, providing an introduction to the instrument for all students taking courses in this Department.

This faculty successfully employed a SEM in the instructional program until the demise of their former instrument several years ago. The old SEM had featured prominently in student research projects. Based on their educational experience with the earlier, somewhat primitive instrument, they now have selected a modern, more adaptable instrument—the Zeiss DSM 950. The virtues of this instrument include its ease of operation for students and its digitalized design which allows integration into existing computer facilities, providing enhanced capability for automating analyses. The Department already possessed the requisite ancillary equipment such as coating devices, critical-point drying apparatus and computer facilities. Thus funds were needed only for the SEM itself. A substantial contribution from the Hilden Trust, when added to the College matching funds, has provided a substantial overmatch to the Federal grant for this project.

Banadakoppa T. Lingappa  
College of the Holy Cross  
Worcester, MA

CSI 8750960  
\$21,064

**"Equipment to Support Interdisciplinary Research in Anaerobic Bioconversion for Undergraduates"**

This biology-based interdisciplinary project offers an opportunity each year to nearly 40 undergraduates, drawn from diverse subdisciplines of science and humanities, to engage in research in anaerobic bioconversion. This research is of value in educating the liberal arts students, many of whom will become decision makers at various levels in the private and public sectors, to a number of societal problems connected with the disposal of solid wastes. Through field research and laboratory experience, students

investigate the physical and chemical composition of biomass (local municipal solid waste, agricultural and animal wastes) and the biological and physical parameters of the anaerobic process that converts the waste biomass into useful chemicals and fuel. Using modern laboratory equipment, science and nonscience students cooperate in generating data on anaerobic digestion.

The grant is providing a gas chromatograph, fermentors, photo-micrographic equipment, and a system for computerized data collection and analysis. With these tools the students are studying such topics as the microbial colonization of the biomass surface, the amount and composition of gases/chemicals produced, reduction of total/volatile solids, and resource economics. This interdisciplinary approach to learning sensitizes science majors to societal concerns, as well as influencing non-scientists to develop a regard for science and an appreciation of its potential for helping solve many of the problems faced by the citizens of a modern technological society.

Craig Weatherby  
Adrian College  
Adrian, MI

CSI 8750442  
\$7,977

**"Computer-Aided Radio Telemetry Equipment for Undergraduate Studies in Animal Behavior and Ecology"**

Laboratory experiences are being introduced to illustrate and test theories of animal behavior and ecology that are presented in the lectures of five existing courses. The computer-aided radio telemetry equipment also is providing advanced undergraduate research opportunities in the disciplines of ethology and ecology, providing undergraduate access, experience, and familiarity with the equipment.

The animal behavior and ecology topics that are being developed for incorporation into the Department's laboratory course work and undergraduate research include home range, territoriality, habitat preferences and partitioning, cyclic activity patterns (circadian and seasonal), dispersal patterns, refugia selection, social organization, and the effects of age, season, and sex on any or all of the above.

Paul R. Sotherland  
Kalamazoo College  
Kalamazoo, MI

CSI 8750850  
\$9,846

**"Computerized Data Acquisition in Undergraduate Animal Physiology Laboratories"**

Computerized Data Acquisition is being developed as a part of the laboratory for an upper-level course in Animal Physiology. The course consists of a lecture series based

on the textbook *Animal Physiology: Mechanisms and Adaptations* by R. Eckert and D. Randall, and a laboratory. A series of experiments give students an opportunity to collect physiological data using a computerized system. Students use transducers interfaced with an IBM-XT microcomputer to monitor processes in an experiment through the Lab Linc system. Using the data handling software, Videograph, the students simultaneously store the data on a floppy disk.

Undergraduates completing these experiments have a better understanding of concepts and of state-of-the-art methods in *Animal Physiology*, and thus are better prepared to do further work in this area. In addition to its utilization in course work, the equipment is being used extensively by both Health Science and Biology majors, all of whom are required to complete independent study projects.

James S. Backer  
Concordia College at Moorhead  
Moorhead, MN

CSI 8750632  
\$23,255

#### **"Undergraduate Laboratory Equipment for Isolating DNA, RNA, Proteins and Lipids"**

This equipment is providing the Biology Department with the ability to isolate DNA and RNA through ultracentrifugation. The microfuges are being used for the easy manipulation of small volumes (10-200  $\mu$ ) of RNA and DNA. Protein purification experiments and enzyme studies are being done in Cell Biology and in Plant Physiology using slab gel electrophoresis techniques which make cross sample comparisons easier than with tube gel electrophoretic systems. By working in the laboratory with DNA, RNA, and protein, the students gain hands on experience and greater insight into the major conceptual underpinnings of molecular biology and molecular genetics. In addition to its applications in six upper division courses, the equipment will support a newly instituted Honors Program in Biology.

William H. Heidcamp  
Gustavus Adolphus College  
Saint Peter, MN

CSI 8750085  
\$41,011

#### **"Instructional Equipment for an Undergraduate Cell Biology Laboratory"**

This project is improving undergraduate laboratories in all Biology by adding equipment to conduct the separation and characterization of macromolecules through centrifugation, electrophoresis, spectrophotometry and similar techniques. The Principal Investigator is developing a Laboratory Techniques Manual featuring "do-able" exercises for undergraduates at three levels: I, Basic Procedures; II,

Intermediate Level Techniques; and III, Advanced protocols. His report of this work to the American Society for Cell Biology has elicited so favorable a response that prospects for this project's achieving a substantial national impact are encouraging.

Careful scheduling of the laboratories will permit the same instruments to contribute to modernization of the Department's teaching of Molecular Biology, Microbiology, Immunology, Genetics and Biochemistry, as well as serving their central function in Cell Biology.

Daniel J. Hornbach  
Macalester College  
Saint Paul, MN

CSI 8750483  
\$17,773

#### **"Equipment for an Undergraduate Field Station Laboratory to Provide On-Site Instruction in Terrestrial and Aquatic Ecology"**

The Biology Department is unusually fortunate in owning a 300-acre field station located within 20 miles of the main campus. The field station contains a number of different terrestrial and aquatic habitats: prairies and forest, ponds and river. Located at the field station is a laboratory building staffed by a resident naturalist. The field and laboratory equipment provided through this award are making this field station selfsufficient and more fully functional.

The new field equipment includes soil and water test kits; the laboratory equipment includes microscopes, balances, drying ovens, and a microcomputer for data storage and analysis. Since the station already has adequate dormitory space, the addition of a fully equipped laboratory allows students to live and conduct meaningful research on site. The equipped station laboratory is particularly valuable during the January interim term when students may study a single topic in depth. With guidance from the resident staff and from the two Ph.D. ecologists on the Biology faculty, the field station now is able to introduce substantial numbers of undergraduates to a high degree of sophistication in studying ecological research methods.

Steven D. Mercurio  
Mankato State University  
Mankato, MN

CSI 8750844  
\$41,628

#### **"A Gas Chromatograph/Mass Spectrometer for Undergraduate Instruction in an Interdisciplinary Toxicology Program"**

This grant has provided the Department of Biology a Hewlett-Packard capillary gas chromatograph (GC) linked to a mass spectrometer (MS) with a direct insertion probe that is being used to facilitate instruction in Toxicology



courses and to facilitate the development of more interdisciplinary undergraduate science projects. Since the MS is an essential tool in the qualitative and quantitative structural analysis of unknown toxicants in the environment, projects have been designed in six courses to teach how the GC/MS functions, and how it is used in Toxicology and in other areas of the Biological and Physical Sciences.

Experiments have been developed to exploit the advantages offered by the GC/MS as well as show the disadvantages of inappropriate use (e.g. unstable antibiotics injected into a GC/MS versus direct insertion into the MS). Student projects involve the use of the GC/MS to detect environmental pollutants and unknown metabolites of well-defined toxic chemicals or medications. Stable isotope analyses, potentially useful to those pursuing human nutritional toxicology research, and experiences with new methods for using the GC/MS (e.g. with theoretical, pure standards and with biological sample spectra) are providing instruction on uses of a low resolution GC/MS in Toxicology.

David K. DeGroote  
Saint Cloud State University  
Saint Cloud, MN

CSI 8750520  
\$24,292

#### **"Instrumentation to Develop an Analytical Chromatography Laboratory for Undergraduate Biology"**

With the high performance liquid chromatograph and gas chromatograph procured through this project, undergraduates in this Department are integrating theory and practical experience through applying the techniques of separation technology across a wide range of biologically important classes of chemicals. Naturally occurring or synthetic substances in the environment are discussed and are being identified or quantitated by laboratory procedures that are presented in a broad spectrum of courses.

Providing hands-on laboratory experience brings a depth of understanding of modern Cellular/Molecular Biology and Biochemistry that cannot be conveyed through lectures alone.

Alice J. Burton  
St Olaf College  
Northfield, MN

CSI 8750343  
\$21,670

#### **"Undergraduate Laboratory Equipment for the Teaching of Genetics"**

The equipment provided through this award is improving the undergraduate laboratory for students enrolled in the intermediate-level Genetics course. One set of experiments is based on recombinant DNA technology (espe-

cially as it is applied to the sequencing of DNA), while a second set emphasizes gene product isolation and the genetic control of development. The work on recombinant DNA technology includes a number of steps which can be carried out conveniently in the structured laboratory setting. The essential simplicity of the experiments provides an experience which clarifies the section of the lecture program which emphasizes molecular genetics. These steps also introduce the students to several widely used physical methods (e.g., agarose and acrylamide gel electrophoresis, ultracentrifugation) and incorporate such standard biological techniques as transformation and replica plating in relevant ways. Gene product isolation from *Drosophila melanogaster* and *Caenorhabditis elegans* introduces students to the biology of these widely studied organisms and to the characterization of proteins.

The additional equipment secured through this award (electrophoresis units, high voltage power supply, microcentrifuge, sonicator, shaker bath, gel slab dryers, ultracentrifuge and rotor) permits students to perform these experiments in their logical order (rather than having the order imposed by equipment availability), in this way gaining an understanding of the many applications of molecular techniques to solving basic questions in Genetics.

Walt W. Lilly  
Southeast Missouri State Univ  
Cape Girardeau, MO

CSI 8750903  
\$23,855

#### **"Centrifugation Equipment to Enhance Undergraduate Education in Molecular Biology"**

The modern methods of Molecular Biology have transformed the knowledge and skills expected of Biology majors. Unfortunately, the illustrative experiments required for effective transmission of the knowledge and acquisition of the skills are equipment intensive and expensive.

The laboratory experiences of majors in Cellular and Molecular Biology are being modernized through the use of an ultracentrifuge and accessories purchased through this award. The ultracentrifuge is being used in laboratories in General Genetics, Molecular Genetics, Experimental Cell Biology, Immunology and Virology. Students are gaining hands on experience with the instrument in a variety of situations including organelle and macromolecule isolation, plasmid isolation, and bacterial transformation by recombinant DNA methods. In addition, the instrument is being used to support independent studies by undergraduate students.



Jerome J. King  
College of St Mary  
Omaha, NE

CSI 8750201  
\$7,193

#### **"Computerization of the Introductory Physiology Laboratory"**

Computer-based technology in areas of data collection, storage, retrieval, display, manipulation, and interpretation is growing rapidly. Use of such technology provides an excellent learning environment/program in an introductory Human Physiology laboratory. For some years, students have collected and interpreted data related to physiological concepts by using transducers, monitors and bioamplifiers. By combining an IBM XT computer and Coulbourn's physiology research system, students now are able to store the data and to develop simulations based upon them. Use of such models permits them for example, to observe the effects of an experimental intervention without actually putting the subject at risk. The system is bridging concepts in physiology and computer information management, allowing students to further advance their science education as well as to develop their skills with computer applications.

Daniel J. Lavoie  
Saint Anselm College  
Manchester, NH

CSI 8750891  
\$17,632

#### **"The Research Commons Approach to Teaching General Biological Research Processes"**

The special characteristic of this project is its plan for creating a "research commons" for undergraduate science majors. A student research and study suite surrounded by faculty offices has been established and equipped to support a curriculum that places major emphasis upon students' learning through research participation. Basic scientific skills in research are being developed by underclassmen through regular use of microscopes, spectrophotometers, and related equipment. By requiring all Biology, Natural Science, and Biochemistry seniors to participate in student research, graduates leave the program with ability to design, plan, and execute experiments, to critically evaluate experimental results, and to design new experiments based on such evaluations. The students also are developing skills in reporting and communicating ideas and experimental findings in both informal and formal presentations.

The new equipment is aimed at meeting the needs of the students for experience in conducting research under faculty direction. The physical reorganization of the Department is complete, the faculty are all actively directing student research, and now the equipment needs are being met. This places the Department in a strong position to accomplish its goal of developing problem-solving capa-

bilities in its majors and not just providing them with an accumulation of biological facts.

William J. Bacha, Jr.  
Rutgers University Camden  
Camden, NJ

CSI 8750222  
\$6,575

#### **"Equipment for Preparing Plastic Histologic Sections for an Undergraduate Light Microscopy Program"**

Undergraduate Biology students enrolled in a course entitled *Microtechnique and Its Applications* are using the appropriate state-of-the-art instrumentation to enable them to successfully cut semithin (0.5-2.0 micrometer) plastic histologic sections. An LKB HistoRange Microknife Maker is being used to make glass Ralph Knives, which in turn are being used to cut tissue specimens in an LKB HistoRange Microtome.

These instruments enable the students to cut semithin sections of plastic-embedded tissue specimens. The processing of plastic sections is an important advance in modern technical histology. Stained, semithin preparations provide better detail of histologic structure than can be obtained by other methods. It is important, therefore, that undergraduates learn and practice the methodologies involved in order to keep abreast of current advances in the field.

David W. Johnson  
College of Santa Fe  
Santa Fe, NM

CSI 8750401  
\$12,999

#### **"Equipment for Improving Undergraduate Studies in Physiology and Microscopy"**

As part of a major institutional effort to enhance the Biology program for science majors, prospective science teachers, and non-science students, this project is providing two types of laboratory equipment: a physiograph system for detecting, recording, and quantifying basic physiological functions, and stereoscopic microscopes for examining and identifying small organisms.

The equipment is being used by a variety of students, from first-year Biology majors and Science Education students to advanced students conducting independent research. About one-half of the students belong to an underrepresented minority—Hispanic, Native American, or Black. A substantial number also are non-traditional, older students acquiring advanced education in order to enhance their ability to work in science- or technology-related employment. Most are women.

Rivka Rudner  
CUNY Hunter College  
New York, NY

CSI 8750842  
\$45,150

**"Equipping an Undergraduate Instructional Laboratory with the Tools of the Molecular Biologist"**

Recent advances in Molecular Biology and Molecular Genetics are significantly changing the laboratory approaches required for training undergraduates majoring in Biology. The Hunter College faculty has prepared a revised and expanded one-year Molecular Biology course for undergraduate majors which includes two updated laboratory courses in the areas of Biochemistry and Molecular Genetics. The revised and expanded curriculum (emphasizing basic cloning techniques, analysis of the plasmids present in recombinant clones, isolation and characterization of enzymes, and structural analysis of cell surfaces) will give students increased hands-on laboratory experience with molecular procedures and scientific instruments. In addition, increased access to the course for students with limited experience in the tools of scientific investigation will be possible.

For the experienced students there is opportunity to expand their existing knowledge by using modern molecular techniques for an independent honors research project. Additional changes in the two laboratory courses are also projected with the utilization of this same equipment. The major items being used to implement these changes include high speed ultra- and micro-centrifuges, a scintillation counter, shaker incubator and a speed-vac system. A large fraction of the students benefitting from these courses are women and/or members of minority groups underrepresented in the Nation's pool of scientists.

Robert F. Pohlman  
Colgate University  
Hamilton, NY

CSI 8750861  
\$50,000

**"Instrumentation for an Undergraduate Recombinant DNA Laboratory"**

Instrumentation acquired through this project is being used to initiate a two-semester Molecular Biology course in which undergraduates learn recombinant DNA methodology in the laboratory. Major instruments include an ultracentrifuge with two rotors, UV spectrophotometer, power supplies, DNA sequencing apparatus, constant temperature shakers for bacterial growth, a scintillation counter, and two microcomputers with hard disks. The instruments will be used in a series of 10-week laboratory exercises each semester for students in the Junior year. These exercises will acquaint students with the growth of bacteria, bacteriophages and plasmids, the subcloning of phage genes

into plasmid DNA, bacterial transformation with recombinant DNA, site-specific mutagenesis, the construction of a genomic library, nucleic acid filter hybridization, and an introduction to DNA base sequence analysis.

The course prepares students for active involvement in undergraduate research projects in Molecular Biology in their Senior year. The faculty anticipates that this course will create such enthusiasm that an increased number of students will consider scientific research careers in the fields of molecular and cellular biology.

Nancy L. Pruitt  
Colgate University  
Hamilton, NY

CSI 8750793  
\$40,014

**"Physiological Instrumentation for Basic and Advanced Undergraduate Laboratories"**

The Department of Biology is upgrading its basic Animal Physiology course with the acquisition of sophisticated, state-of-the-art equipment. The new equipment includes such electrophysiological instrumentation as microcomputers to interface with dual channel oscilloscopes, pressure transducers, polygraphs, and accessory equipment—all of which have a wide range of applicability and flexibility. Students taught on this new equipment will be prepared to enter the upper level courses in the Department in such diverse subdisciplines as Physiological Ecology, Endocrinology, Advanced Cellular Physiology and Neurophysiology. The high percentage of students who pursue graduate education in Biomedical fields and the historically high demand for training in Physiology indicate that this equipment is being used productively.

Joel T. Kerlan  
Hobart and William Smith Colleges  
Geneva, NY

CSI 8750916  
\$14,550

**"Growth Chambers for use in Laboratory Studies and Undergraduate Research"**

Students are exploring the effects of varying environmental stimuli on plant and animal systems with the assistance of two new Conviron E15 Plant Growth Chambers acquired through this project. The controlled environmental chambers are complementing the Department's greenhouse and nature preserve in ways that improve the laboratories in five courses—as well as expanding undergraduate research options. The chambers are making it possible to conduct experiments at the cellular, organismal and population level on the effects of varying temperature, light and humidity.

A new array of questions now can be asked in the undergraduate laboratory courses, the answers to which are

providing students with a more complete understanding of how an organism functions in its native environment, and how abiotic factors affect the physiology and behavior of all living things.

Brian R. Shero  
Medaille College  
Buffalo, NY

CSI 8750282  
\$24,425

#### **"Equipping a Microscope Resource Center for Undergraduates"**

The College is organizing a single laboratory into an all-purpose Microscope Resource Center housing all of the College's microscopes and related equipment, allowing for maximum utilization of equipment at the lowest cost to the College.

The center is serving the Animal Health Technology program as well as the Biology Department. A microvideo camera unit and the new microscopes themselves are aiding the introductory students through expanding their capability for viewing samples of special interest.

Bonnie M. Sampsell  
Douglas P. Easton  
Hadar Isseroff  
Gary W. Pettibone  
SUNY College at Buffalo Buffalo, NY

CSI 8750648  
\$22,612

#### **"Improvement of Undergraduate Advanced Cell Biology and Recombinant DNA Technology Courses"**

The equipment purchased through this award is being used to improve the laboratory components of two courses: Advanced Cell Biology and Recombinant DNA Technology. The courses are designed to present the fundamentals of experimental procedures and to provide opportunities for extensive practice with different pieces of equipment under the supervision of experienced researchers.

Among the competencies being developed are microscopy, spectrophotometry, electrophoresis of proteins and DNA, growth of bacteria, and the isolation and manipulation of recombinant DNA. Use of computer programs to analyze molecular structures also is being taught. A phase contrast microscope, two UV-VIS spectrophotometers, gel boxes and a power supply for electrophoresis, an incubator/shaker and a sterile hood for growing and handling bacteria, a computer and computer software—all purchased with help from this grant—are being used to illustrate current techniques commonly encountered in Molecular Biology. Students completing the two courses are learning habits and skills that they can use in graduate

school or in an entry-level position in a research laboratory. Many graduates of the program will become science teachers at the pre-collegiate level.

Currie D. Marr  
SUNY College at Oneonta  
Oneonta, NY

CSI 8750023  
\$11,160

#### **"Plant Growth Chambers for Undergraduate Laboratories"**

Ten Botany courses in the Biology curriculum share a common need for environmental growth chambers where factors of light, temperature, and relative humidity can be regulated to observe their effects on plant growth and behavior. The wide range of biological phenomena being investigated using the two new PT-80 Percival Growth Chambers include the initiation of the sexual phase in algae and bryophytes, the study of physiological processes in various groups of plants, developmental differentiation in plant organs and in callus tissue, and the effects of environmental factors on growth, survival and competition in populations of native plants. The growth chambers also are being utilized in the study of ectomycorrhizae by General Mycology students, and in conducting tissue culture experiments in Plant Growth and Development and Biotechnology courses.

Steven J. Coggin  
Michael J. Baranski  
Catawba College  
Salisbury, NC

CSI 8750386  
\$30,256

#### **"Modern Cellular and Molecular Biology in the Undergraduate Curriculum"**

Modern Cellular Biology and Genetics courses for majors are being developed with the purchase of major instruments including a tabletop ultracentrifuge, a high speed refrigerated centrifuge, three general-use spectrophotometers and five phase contrast microscopes. The equipment is being used in the preparation of cell extracts and enzyme assays, plasmid purification, recombinant DNA techniques, organelle isolation, the observation and experimental manipulation of cell-cell interactions using animal gametes, and for various undergraduate research topics in Cellular and Molecular Biology.

John F. Brauner  
Jamestown College  
Jamestown, ND

CSI 8750255  
\$47,692

#### **"Undergraduate Biology & Chemistry Equipment for Upgrading Course Laboratories and Student Research Opportunities"**

The new instructional equipment procured through this project is raising the quality of nearly every course taught



in the Biology and Chemistry Departments. This wide-spread impact results from the way it is enhancing the laboratory experience so that the experimental skills and techniques developed by these students are better matched to the high level of theoretical training they traditionally have received here. The degree of change varies among the courses, with the greatest initial improvements being seen in the upper-level courses and in the Junior-Senior Research Seminar experience.

The new equipment has been selected for maximal student utilization, as well as for its relevance to modern technology. Student interest in the sciences is finding strong reinforcement through their greatly increased opportunities to actually engage in scientific laboratory work, rather than merely hearing about it in the lecture hall.

Dennis J. Taylor  
Hiram College  
Hiram, OH

CSI 8750865  
\$22,389

#### **"Instrumentation for Undergraduate Studies of Physiology, Endocrinology, Cellular and Molecular Biology"**

Student laboratory opportunities in Molecular and Cellular Biology, Endocrinology and Physiology are being enhanced, and increased opportunities for undergraduate research and internships are being provided through the purchase of needed instructional instruments. Renovated cell culture and endocrinology laboratory facilities as well as new instrumentation for enzyme-linked immunosorbent assays, cell culture, high pressure liquid chromatography, and spectrophotometry are providing significant links between students' laboratory and field experiences in whole organismal biology at the College's field station and their laboratory experiences in Cell Biology, Physiology, Microbiology and Endocrinology on campus.

Increasing student understanding of both the potentials and the limitations of blood screening procedures also is being gained by non-majors through use of the enzyme-linked immunoassay equipment procured under this award. Such socially relevant laboratory experience is an important aspect of education for non-scientists who will be decision makers in a technology-based society.

Dorothy E. Jegla  
Kenyon College  
Gambier, OH

CSI 8750368  
\$13,683

#### **"Equipment for Teaching in Vitro Plant Tissue and Organ Culture Techniques to Undergraduates"**

Laboratory exercises incorporating plant in vitro culture techniques are being developed in the Plant Sciences. These

exercises require the use of culture chambers to maintain the cultures for such specific exercises as corn embryo development (Introduction to Experimental Biology); isolation and culture of the carnation shoot apex (Plant Biology); and leaf disc transformation of tobacco using *Agrobacterium tumefaciens* (Plant Biology). The culture chambers also are being used for student Honors and Independent Research projects, as well as for the laboratories associated with courses in Plant Physiology and Molecular Biology.

Dennison A. Smith  
Oberlin College  
Oberlin, OH

CSI 8750118  
\$14,448

#### **"Equipment for an Undergraduate Neurochemistry and Neuropharmacology Laboratory"**

A novel interdisciplinary Neurochemistry/Neuropharmacology laboratory is being introduced into the Neuroscience curriculum at Oberlin College. The High Performance Liquid Chromatograph (HPLC) is being used to bring better chromatographic techniques into this laboratory. At the same time, improved centrifugation assay techniques are being added. With a tissue homogenizer to produce rapid and uniform cell disruption of large tissue samples prior to HPLC and centrifugation assays, a full array of biochemical research techniques for examining the nervous system is becoming available to this program.

Adding a laboratory in Neurochemistry/Neuropharmacology to the curriculum allows students to apply the knowledge and skills they have acquired in basic Biology and Chemistry courses to issues and problems in Neuroscience; increases the sophistication of undergraduate research that is being undertaken; gives students a broader exposure to the approaches and methodologies currently used in the Neurosciences; attracts to the program students (particularly students with an interest in Chemistry) who previously have had little contact with the Neurosciences, and demonstrates the interdisciplinary nature of research in the Neurosciences.

Charles J. Kunert  
Concordia College  
Portland, OR

CSI 8750673  
\$9,153

#### **"Facilitation of Research by Undergraduates in Life Science"**

The Life Sciences Department is requiring an independent research project as a component of its curriculum for majors. This Senior-year project is involving students in research with a particular focus upon Molecular Biology.



Powerful motivators, the projects provide students an environment for developing modern laboratory skills and techniques while pursuing a currently important biological question. As a result, these undergraduates better comprehend the essence of science while at the same time they gain better preparation for entering careers based on scientific processes. Participants are being encouraged to communicate the results of their research to their peers and to other scientists through publication and/or oral presentation of their work.

The new equipment provided through this grant is being used for basic work in Molecular Biology, including the purification and experimental manipulation of nucleic acids. The simplicity of many of the techniques employed in Molecular Biology makes it feasible for undergraduates to accomplish significant work if properly motivated and supervised.

Darlene H. Southworth  
Southern Oregon State College  
Ashland, OR

CSI 8750176  
\$28,354

#### **"A Scanning Electron Microscope for Undergraduate Biological Instruction and Independent Research"**

Using the scanning electron microscope (SEM), a critical point dryer and a sputter coater, the College is bringing to its Biology curriculum a new upper-division course on the Principles and Methods of Scanning Electron Microscopy. Students enrolling in this course gain enhanced understanding of the methods of scientific investigation, greater ability to interpret biological structure, and improved technical skills. An important additional benefit of the facility is the increased opportunity for student research it affords. A substantial fraction of the Department's graduating group of 15 majors annually will have done independent work in ultrastructure. Pre-service Biology teachers, plus upper-classmen from chemistry, geology and physics, also will have access to the SEM and ancillary specimen preparation equipment. Topics include electron optics (theory, lenses, resolution), SEM design and operation, specimen preparative techniques (fixation, dehydration, coating), interpretation of images (measurement and shrinkage), surface labelling, elemental analysis, SEM applications to a wide range of organisms and questions, and laboratory safety.

The SEM capability is having a valuable secondary impact on the Department's work in Developmental Biology, Plant Anatomy, Systematic Botany and Entomology, among others. Since SEM preparation does not require time-consuming thin sectioning, it is superior to transmission electromicroscopy in this wide variety of undergraduate applications.

Gerald L. Kreider  
Albright College  
Reading, PA

CSI 8750872  
\$8,462

#### **"A High Speed Centrifuge to Complete the Development of an Undergraduate Course in Molecular Genetics"**

A course in Molecular Genetics is being developed with a laboratory that emphasizes gene cloning techniques. This project is providing a high speed refrigerated centrifuge for use in large-scale preparative procedures (plasmids, competent cells, DNA fragments). Other equipment needed for this laboratory already has been acquired and currently is being used by undergraduates to test suggested protocols for actual class experiments in Molecular Genetics—experiments that are designed to enable the undergraduates to understand and apply modern methods for analyzing genetic systems at the molecular level.

The unique value of this project for small, undergraduate Biology programs is that it uses readily available equipment, microbial strains, reagents and procedures; provides exposure to nucleotide sequencing and Southern blotting techniques without use of radioactive isotopes; and is one that can be implemented safely in any physical facility which conforms to the standard safety features found in most college Microbiology laboratories. Available microcomputer software, some in the public domain, is incorporated in laboratory applications used for sizing restriction fragments of DNA and for nucleotide sequence analysis.

Felicia Corsaro-Barbieri  
Gwynedd-Mercy College  
Gwynedd Valley, PA

CSI 8750069  
\$7,400

#### **"Integration of Biochemical Analysis Techniques into an Undergraduate Biology Curriculum"**

In order to increase and modernize the Biology majors' expertise with biochemical instrumentation, a three-step project is being undertaken: techniques of analytical chemistry are being introduced earlier into the Biology curriculum; students are being exposed to more current and sophisticated techniques through the acquisition of a high-performance liquid chromatography system and ultraviolet-visible spectrophotometers; and the Biochemistry laboratory course is being converted from a survey of biochemical reactions to a course that includes a significant exposure to modern biochemical techniques.

Biology graduates who are familiar with these additional instrumental techniques are expected to have a deeper understanding of major issues in modern Biology and thus to be able to compete successfully for positions in graduate and professional programs of study and for employment opportunities.

M. Kaye Edwards  
Haverford College  
Haverford, PA

CSI 8750418  
\$50,000

**"Acquisition of a Transmission Electron Microscope for Undergraduate Instruction and Research"**

Through this project, the Biology Department of Haverford College is purchasing a modern transmission electron microscope to support undergraduate instruction and research. All biology majors learn to operate the new Hitachi H-600-3 in their Junior year as part of an intensive laboratory course in cell and molecular biology. The technical and analytical skills gained in this course form the foundation for further work in independent Senior research courses, which regularly result in scholarly publications co-authored by students. Five faculty members in addition to the Principal Investigator will sponsor undergraduate investigations employing this sophisticated instrument.

Paul M. Tefft  
St Joseph's University  
Philadelphia, PA

CSI 8750549  
\$22,985

**"Integration of Tissue Culture Techniques into the Undergraduate Biology Curriculum"**

With equipment procured through this project, modern techniques of tissue culture are being incorporated into the Biology curriculum. In the sophomore course required of majors and in the five upper division courses, these techniques are being used, e.g., to carry out experiments in viral infection, plant and animal organ/tissue explantation, the formation of hybridomas, and plant and animal morphogenesis. The plant growth cabinet and the growth chambers provide environments for controlled experiments and for the propagation of living material used in the various labs.

Controlled environmental conditions are essential for many of the experiments. A contamination-free environment also is required to protect both the aseptic culture material and the students. A sterile and safe environment is being provided by the laminar flow hood. Finally, undergraduates now have modern phase contrast, inverted and fluorescence microscopes for use in their studies in Cell Biology and tissue culture.

Jack Waber  
Elise Triano  
West Chester Univ of Pennsylvania  
West Chester, PA

CSI 8750434  
\$26,600

**"Instrumentation to Improve Undergraduate Instruction in Physiology and Cellular Biology"**

A modern, high technology-oriented physiology laboratory to support the physiology and cell biology courses is

being equipped through this award. These courses constitute an integral part of the Biology program and are fundamental to the students' understanding of life processes. Explanations of biological phenomena are increasingly sought at the biochemical level, and are arrived at by employing sophisticated, instrument-oriented techniques such as radioactive labeling of cellular components, spectro-photometric analyses of enzyme activities and metabolic concentrations, and chromatographic procedures for separating complex mixtures into their individual components. A UV/VIS spectrophotometer, a high pressure liquid chromatographic system, and a computer link-up that provides instrument control and data analysis are being added. At least three courses are benefitting directly. In addition, a new instrumentation course is being developed.

In the field of modern molecularly-oriented biology, skill in the use of these techniques and supportive instruments is second only in importance to the students' understanding of the biological concepts for which they are employed.

Hector Quintero  
Inter American University of Puerto Rico  
San German Campus  
San German, RQ

CSI 8750717  
\$24,413

**"Field and Laboratory Equipment for an Undergraduate Ecology and Environmental Sciences Program in the Caribbean"**

The recent acquisition of a core set of ecological instrumentation is making it possible for this Department to expand its upper-level courses as well as to widen the range of the student-oriented research projects it can offer. This development project thus forms an integral part of an ongoing University plan to emphasize the sciences.

The specific impact of this project is on undergraduate instruction in Ecology and the Environmental Sciences. Among the new resources now available to the students are an oceanographic field kit, portable conductivity/salinity meter, dissolved oxygen and biological oxygen demand meter, core sampler and electronic soil testing lab, recording weather station, air quality monitoring devices, and sophisticated laboratory apparatus for studying environmental samples brought in from the field for more exacting analysis. This improvement will result in a better prepared graduate of the University who in turn will be better able to perform at the professional level after graduation. The Caribbean area in particular and tropical America in general are in urgent need of trained ecologists to help stem the current catastrophic losses of such natural resources as forest cover, soils and biological diversity, and to help cope with the effects of such losses.

Freddy R. Medina  
Inter American University of Puerto  
Rico—Metropolitan Campus  
Hato Rey, RQ

CSI 8750497  
\$43,244

Oscar H. Will, III  
Larry L. Tieszen  
Augustana College  
Sioux Falls, SD

CSI 8750043  
\$18,417

#### **"Equipment to Upgrade the Undergraduate Biology Curriculum, with Emphasis on Microbiology"**

The aim of the project is to give Microbiology, Medical Technology, and Pre-Medical students more "hands on" experience in the undergraduate laboratories, particularly using the kinds of modern equipment adopted by the pharmaceutical, food and medical industries, and by graduate schools.

The new spectrophotometers are being used in the General Microbiology course to construct growth curves of bacteria, in the Parasitology course to perform experiments on enzyme kinetics, and in Immunology to carry out protein concentration determinations. Laminar flows, the inverted microscope, the CO<sub>2</sub> incubator and the new centrifuge are being used in Immunology courses to manage Myeloma cells. The miniature and horizontal electrophoresis systems, the transilluminator, shaking incubator and micro-centrifuge are used to construct physical maps of plasmids in the Cellular/Molecular Biology course. The Biostat fermenter is used in the Industrial Microbiology course for the continuous culture of various microorganisms of industrial interest. With the equipment provided through this project, students are learning to use electrophoresis, DNA recombination, enzyme kinetics, and ELISA techniques, and are mastering principles of tissue culture and the importance of Myeloma cells.

George W. Shiflet, Jr.  
Erskine College and Seminary  
Due West, SC

CSI 8750138  
\$26,854

Catalina Fresquez  
Gerald F. Doebbler  
Incarnate Word College  
San Antonio, TX

CSI 8750970  
\$11,696

#### **"Improved Teaching of Analytical Methods in an Undergraduate Molecular-Cellular Biology Laboratory"**

This Biology Department is implementing a curricular change which is designed to provide Biology majors and other Science students with experience in using a modern, quantitative approach in their laboratory studies rather than the more descriptive approach of former years. Most changes involve the Molecular-Cellular Biology course which is being expanded into a two-semester format. There is a parallel upgrading of its laboratories under way.

New, significantly improved laboratory exercises are being made possible through the acquisition of a gas chromatograph, a UV-visible spectrophotometer and a liquid scintillation counter. Further improvements in the program are being made by extending the Department's new analytical capabilities to other courses, and by supplementing such work in the introductory laboratories for Science majors.

#### **"Equipment to Enhance an Undergraduate Biotechnology Curriculum"**

New thrusts in Biotechnology are being provided in the curriculum at the freshman, sophomore and advanced levels. Related laboratory experiences include work in modeling, DNA manipulation, fermentation, and tissue culture using agarose gel electrophoresis and electro-blotting. New equipment supporting these advances include a hood, a freeze dryer and a computer-based data acquisition system. Three tissue culture, three DNA manipulation, a stable isotope plant selection exercise, and two computer modeling lab sessions are being added to existing courses.

A new lab oriented-course called Biotechnology also is being developed. Its major components involve recombinant DNA methods, fermentation, bioproduction and bio-conversion, eukaryotic tissue culture and differentiation, and simulation modeling. Enhanced educational opportunities in experimental and quantitative Biotechnology are being provided, and a regional need for formal education in Biotechnology is being met.

#### **"Equipment for Undergraduate Instruction in Biochemistry, Molecular Biology and their Applications in Biotechnology"**

Two laboratory courses are being developed which are giving undergraduate Biology majors experience with state-of-the-art techniques in modern Biochemistry and Molecular Biology. The project's focus is on preparing Hispanic women and other minority and non-traditional students for careers in local Biotechnology-based industries. Courses affected include (in addition to Biochemistry) DNA Technology, Genetics and Immunology.

Existing equipment for spectrophotometry, ultracentrifugation and isotope counting is being supplemented by essential additional electrophoretic and chromatographic equipment obtained through this grant, making it possible to offer laboratory work in courses where previously such opportunities were lacking.



Harold F. Foerster  
Sam Houston State University  
Huntsville, TX

CSI 8750770  
\$11,587

#### **"Undergraduate Laboratory Equipment for Teaching Molecular Biology and Biotechnology"**

Students in Molecular Biology are carrying out experimental analyses of genes and their proteins with special emphasis on methodologies used to study recombinant DNA and gene cloning. The instrumentation purchased through this award is being used for the electrophoresis procedures which chemically separate and identify proteins and DNA fragments. The major equipment items include vertical and horizontal slab gel electrophoresis units and various supportive instrumentation—a microcentrifuge, scanning densitometer, constant temperature incubator, shaker bath, analytical balance, and pH meter.

The student experiments are being developed around a model gene-protein system in *Bacillus*, a spore-forming group of bacteria in which heat-resistant spores are produced that contain sizeable quantities of small, acid-soluble proteins (SASP). Such proteins play important, but not yet fully understood, roles in spore germination. Students are isolating and identifying SASPs, and are determining the number of genes involved in the coding their production.

Sandra Boatman  
Hollins College  
Hollins College, VA

CSI 8750380  
\$7,160

#### **"Electrophoretic Equipment for Improving Undergraduate Biology and Chemistry Programs"**

Electrophoretic equipment is being used to improve undergraduate Biology and Chemistry laboratories associated with courses in Biochemistry, Molecular Genetics and with the Undergraduate Research program. Among the major new instruments acquired through this award are vertical and horizontal slab gel and transfer electrophoretic apparatus (with their respective power supplies), a scanning densitometer, transilluminator and photodocumentation equipment. Their purchase is making it possible for the undergraduate women in these classes to gain experience with techniques that are central to modern Biology, Biochemistry and Molecular Biology, and for the College to continue to provide instruction and research experience at a high experimental level.

Eugene V. Gourley  
Radford University  
Radford, VA

CSI 8750261  
\$25,500

#### **"Environmental Chambers to Improve the Undergraduate Biology Curriculum"**

A controlled-environmental room with two chambers procured with assistance from this award is enabling Bi-

ology students to develop a better understanding of experimental design. The laboratories in which these new facilities are being used are designed to give the students hands-on experience in manipulating environmental variables. This provides them with a better understanding of the effects of the various environmental factors on the physiology and behavior of organisms, as well as helping them to improve their investigative skills. Courses to which these chambers are contributing fresh opportunities for student originality and creativity include Animal Physiology, Plant Physiology, General Ecology and Vertebrate Zoology, as well as Independent Research. Since the school is located in the Appalachian Mountains, numerous local mountain species of fish, amphibians, reptiles and small mammals will be employed in these studies.

Alan R. White  
Marshall University  
Huntington, WV

CSI 8750488  
\$42,460

#### **"Instrumentation for a Core Undergraduate Course Laboratory in Cellular Biology"**

The Department of Biological Sciences recently has implemented a curriculum revision involving the creation of three core courses for all majors—namely, Genetics, Ecology and Cell Biology. Of these, Cell Biology had not existed on this campus in the past and Genetics had been in need of revision. Instruments procured through this project are being used to provide current technology to the laboratory portions of both of these core courses.

Included among the new instruments are teaching and instructor's microscopes equipped with phase-contrast optics that provide for more effective observation of living cells, and an ultracentrifuge. The instruments are enhancing both laboratory teaching and student research projects by making the modern techniques of Light Microscopy and of Molecular Genetics (especially methods of isolating cellular components) available to undergraduates.

Virginia B. Brown  
Heritage College  
Toppenish, WA

CSI 8750901  
\$16,309

#### **"Instrumentation for Undergraduate Biochemistry and Cellular Biology Laboratories"**

The high-speed centrifuge, chromatography refrigerator, fraction collector and support equipment acquired in part through this grant are being used to strengthen upper-division laboratory courses in Biochemistry and Cellular Biology for students who are predominantly female, American Indian, and older than the traditional undergraduate.



During the past year, this relatively new independent institution has received accreditation and instituted a four-year curriculum in Science and Mathematics. Funds were obtained from Federal and corporate sources to implement the basic curriculum. The goal of the current project is to develop and enhance capabilities for giving students needed laboratory experiences in upper-level courses in such areas as protein purification and characterization, and the investigation of cellular components. The new instruments are essential components of technical skill training in Biochemistry and Cellular Biology in that they support approximately one third of the experiments in these laboratory courses. This instrumentation also is being used to support experiments in other upper- and lower-division courses in the Science curriculum.

The program is designed to meet the needs of students who, despite limitations in their precollegiate science training, are seeking an education that will adequately prepare them for successful careers in technology, teaching or nursing.

Terrence R. Mace  
University of Puget Sound  
Tacoma, WA

CSI 8750166  
\$18,471

#### **"Equipment to Quantify Undergraduate Course Work and Independent Studies in Animal Behavior"**

This project is expanding and strengthening undergraduate offerings in animal behavior and behavioral ecology through the purchase of equipment that makes it possible to quantify aspects of what has been largely a descriptive field. It facilitates expansion of the range of techniques introduced and used in the laboratory exercises of the Animal Behavior course, and increases the diversity and sophistication of independent study and/or senior thesis projects available to students interested in these areas.

The students use the event recorders to document sequences and temporal patterning of behavior. Tape recorders, a sonograph and a sonogram digitizer are allowing students to record and analyze vocalization in detail—critical elements in understanding territoriality, breeding behavior and other aspects of animal interaction. A motion analyzer makes possible detailed examination of locomotion, stimulus-response sequences, and related phenomena.

Hubertus E. Kohn  
Western Washington University  
Bellingham, WA

CSI 8750902  
\$21,457

#### **"Improvement of an Undergraduate Laboratory Curriculum in Molecular/Cellular Biology"**

Many of the most important recent revolutions in science belong to Biology. The discovery of means to routinely

isolate, sequence, and reintroduce genes into living cells has permanently changed biological teaching and research agendas. The tools of Cell Tissue Culture and Recombinant DNA Technology are providing the basis for an appropriate undergraduate education in modern Biology, and a hope for exploiting the future promise of Biotechnology.

This Department has identified Molecular/Cellular Biology as an area for increased emphasis and, using local resources, has partially equipped an area to include a functional Cell Tissue Culture Laboratory. The laboratory complex is housing a specially designed course "Cell/Tissue Culture", as well as supplementing student experimentation in the Botany, Microbiology, and Genetics courses. Also, a new B.S. degree program with an emphasis in Molecular/Cellular Biology is being inaugurated. Thus the equipment provided through this project is greatly expanding the efficiency, depth, and variety of possible student experimentation in the areas of Cell Tissue Culture and DNA Technology.

James Lorman  
Edgewood College  
Madison, WI

CSI 8750548  
\$5,577

#### **"Environmentally Controlled Chambers to Improve Project-Centered Experience in Biology for Non-Majors"**

Student-originated projects involving scientific experimentation are a key component of the introductory natural science and biology courses required as a part of Edgewood's general degree curriculum. Environmental biology is an area popular with non-science majors. The goal of this project is to expand the experience in scientific problem solving that the College can provide such students. Approximately 75% of the undergraduates who will benefit from this project are female, and a large proportion) approximately 30% ) are teacher education majors.

Using controlled environment chambers acquired through this project, students will be able to mount experiments in plant growth, plant-herbivore interactions and other aspects of environmental biology which require the ability to control such parameters as light intensity, light/dark periodicity, humidity, atmospheres and temperatures. The Department's ability to support controlled experiments in these areas should produce not only expanded experimental capabilities, but also increased interest and enthusiasm on the part of students and, most importantly, a better understanding on their part of the process of scientific inquiry.

William J. Perreault  
Lawrence University  
Appleton, WI

CSI 8750525  
\$12,573

Michael R. Winfrey  
University of Wisconsin La Crosse  
La Crosse, WI

CSI 8750784  
\$47,310

**"Equipment to Improve the Light Microscopy Program in Undergraduate Biology Laboratories"**

A sophisticated light microscope is serving multiple functions within a Department which long has emphasized undergraduate training in microscopy. The basic instrument, a Zeiss model 16 phase contrast photomicroscope, is being used to train undergraduates interested in genetics, cytogenetics and microbiology. The addition of fluorescence capability plus a TV camera, monitor and videotape apparatus has transformed the basic microscope into a tool of enormous teaching and student research potential—the fluorescence capability is supporting modern experiments in neurobiology and cell biology, while the television function is opening up access to detailed studies of the dynamics of living cells. The new laboratory facility is proving to be a superb teaching tool for small groups of students.

James R. Hodgson  
Philip Cochran  
St Norbert College  
De Pere, WI

CSI 8750735  
\$8,105

**"Equipment to Support Undergraduate Instruction in Riverine Ecology"**

A number of recent developments make it highly desirable for this institution to develop its capability to exploit the Fox River as a convenient outdoor laboratory for coursework and independent student research. Included among these are the approval of a new Environmental Science major, increased emphasis on aquatic research by faculty in the Biological Sciences, improvement in water quality and biotic diversity in the Fox River, and the relative inaccessibility of traditional terrestrial and small aquatic sites. (Although limited shore-based sampling was possible before the acquisition of the equipment provided in part through this grant, a lack of sampling gear appropriate for large riverine habitats prevented thorough use of the river.)

Acquisition of a versatile new boat-contained aquatic sampling system with capabilities for electrofishing and for making standard limnological measurements in large aquatic habitats effectively removes that barrier, making possible sound field-based laboratory experiences for undergraduates in this program.

**"Incorporation of Modern Molecular Techniques into the Undergraduate Microbiology Curriculum"**

The Department of Biology and Microbiology is incorporating the methods of modern Molecular Biology and Biotechnology into the undergraduate Microbiology laboratory curriculum. The improvements are providing a strong background in classical Microbiology, as well as giving students hands-on experience with the techniques that have revolutionized Microbiology and other Biological Sciences in the last decade.

Centrifuges, spectrophotometers, electrophoresis equipment, and microcomputers are being used to implement major improvements in Bacterial Genetics and Bacterial Physiology laboratories. These changes ensure that the students receive modern instruction in the methods, principles and applications of DNA isolation, electrophoretic separation of DNA molecules and proteins, gene cloning techniques, DNA sequencing, and the use of computers to evaluate DNA molecules. Tissue culturing equipment is being used to instruct Immunology students in the fundamentals of cellular and humoral immunity and to provide them with experience in tissue culturing.

Robert L. Williams  
University of Wisconsin Oshkosh  
Oshkosh, WI

CSI 8750560  
\$11,774

**"Undergraduate Laboratory Instrumentation for Biotechnology"**

This Department has initiated a series of courses with emphasis in Biotechnology. The new fermentation equipment purchased through this grant is making it possible to offer laboratory components of these courses. One 7.5-liter fermenter and two 2-liter fermenters are updating and supplementing existing equipment used in the Biotechnology related courses, allowing introduction of current fermentation and chemical engineering techniques. This equipment also will be made available to students conducting undergraduate research.

The new equipment helps students acquire hands-on experience with scientific equipment they may encounter as they go on to advanced studies or to employment in Microbiology-, Biology- or Chemistry-based careers.

John J. Ruffolo  
University of Wisconsin Whitewater  
Whitewater, WI

CSI 8750803  
\$28,551

#### **"Equipment to Facilitate Undergraduate Laboratory Investigations in Cellular Biology"**

The project is improving the quality of the laboratory part of a course in Cellular Biology. The laboratory experience is acquainting Biology majors with such modern experimental and analytical techniques of Cell Biology as microscopy, tissue culture, cytological, cytochemical, and labeling methods, methods of cell fractionation (esp. centrifugation), and methods of molecular analysis (esp. electrophoresis). The equipment for this project falls into three categories—microscopy, centrifugation, and electropho-

resis: phase-contrast compound microscopes for observing living cells, phase-contrast inverted microscopes for observing tissue cultures, a fluorescence accessory to detect fluorescent stains and labeled antibodies and a video accessory to facilitate group observations, a tabletop ultracentrifuge for cell fractionation, a micro-centrifuge for molecular techniques, and electrophoresis systems for the analysis of proteins and nucleic acids.

Instead of depending on demonstrations, all students now can be exposed to a more realistic atmosphere of experimental science that encourages originality and the cultivation of research and problem solving skills. Such experience is particularly valuable for students who are planning to enter graduate school, and those who are planning to become Biology teachers.

## **CHEMISTRY**

James D. Fisk  
Samford University  
Birmingham, AL

CSI 8750054  
\$26,000

#### **"Improvement of Undergraduate Instruction in Chemistry through NMR"**

The effectiveness of teaching concepts of spectroscopy has been improved by the Chemistry Department at Samford University through the recent acquisition of a nuclear magnetic resonance (NMR) spectrometer. Students are learning NMR principles and applications of magnetic resonance to chemical structure, first hand, by obtaining NMR information on different types of compounds and correlating this data with NMR theory as well as other spectroscopic information. This results in a composite "picture" of the molecule, and teaches students how chemical structure can be investigated. The instrument is used exclusively by undergraduate chemistry majors and minors in a number of chemistry courses in which a carefully planned group of experiments teach various aspects of the technique in a logical sequence that builds on what students have already learned. This equipment complements existing instrumental holdings and gives the department a more complete arsenal of analytical tools through which to teach spectroscopic methods.

Bert E. Holmes  
Roberta M. Bustin  
Arkansas College  
Batesville, AR

CSI 8750879  
\$25,057

#### **"Infrared Spectrophotometry in Undergraduate Chemistry Instruction"**

The use of a Fourier Transform Infrared (FTIR) Spectrometer with Data Station has recently been integrated into the undergraduate chemistry curriculum of the Chemistry Department at Arkansas College. The instrument is used in Instrumental Chemistry to teach instrumental operation, techniques of sample preparation, and Fourier Transform principles together with spectral interpretation and structure identification. In several courses in organic chemistry, the FTIR is used to characterize products, to indicate product purity, to elucidate structures and determine unknowns. Its uses in Physical Chemistry include the study of vibrational and rotational spectra and the investigation of isotope effects.



Thomas E. Goodwin  
Hendrix College  
Conway, AR

CSI 8750417  
\$8,589

#### **"Acquisition of Infrared Spectrophotometers for Microscale Organic Laboratory"**

In the current trend toward microscale organic laboratories, the recent acquisition of two infrared spectrophotometers by the Chemistry Department at Hendrix College provides students with routine use of this instrumentation as an integral characterization tool for most of the microscale experiments. Additional instructional use is provided in Instrumental Analysis and senior Independent Study. The Department is continuing to develop new environmentally-safer experiments for the microscale laboratory, as well as to develop novel methods for the implementation of established experiments. This acquisition is assisting in the achievement of two general departmental objectives: (1) the introduction of modern instrumentation as a routine tool in introductory chemistry laboratories, and (2) the development of pedagogical models which may be useful to other institutions.

William D. Korte  
California State University Chico  
Chico, CA

CSI 8750218  
\$13,515

#### **"Liquid Chromatography in Undergraduate Chemistry Instruction"**

The addition of an autosampler and fraction collector to existing units has produced a modular microprocessor controlled liquid chromatography (LC) system for the Chemistry Department at California State University, Chico. The added components facilitate the use of the system for large undergraduate classes by automating time consuming separations and semi-preparative purifications and sample collection. The entire system is being used for the experimental enhancement of four chemistry classes, and for undergraduate independent study projects. Five new experiments, using LC technology are being developed for the undergraduate laboratories.

Jeffrey A. Cohlberg  
Margaret L. Merryfield  
Roger Acey  
California State Univ Long Beach  
Long Beach, CA

CSI 8750821  
\$38,778

#### **"Instrumentation for a Newly Revised Undergraduate Biochemistry Laboratory Course"**

A new curriculum for a one-semester biochemistry laboratory course has been designed and is being imple-

mented by the Chemistry Department at California State University at Long Beach. The course is the capstone of a newly approved degree program leading to a Bachelor of Science in Biochemistry. The course emphasizes the acquisition of both experience with modern biochemical research techniques and instrumentation and the acquisition of problem-solving skills used in a research setting. The following equipment has been recently added to the department's instrumental holdings, specifically for use in this regard: a high speed centrifuge, three ultraviolet-visible scanning spectrophotometers, a high pressure liquid chromatography gradient system with variable wavelength detector, and three low pressure liquid chromatography systems. In addition to experiments on protein determination, enzyme kinetics, and gel electrophoresis, the isolation and characterization of hemoglobin, DNA, and messenger RNA, from the brine shrimp *Artemia Salina*, is carried out, together with experiments on the transformation of bacteria with recombinant plasmids and the isolation and characterization of the plasmids.

Eleanor D. Siebert  
Mount St Mary's College  
Los Angeles, CA

CSI 8750280  
\$17,101

#### **"Updating Instrumentation in the Natural Sciences"**

New scientific instruments have been recently acquired by the Physical Sciences and Mathematics Department at Mount St. Mary's College. These include an ultraviolet-visible spectrophotometer, a gas chromatograph (GC) with a micro preparative assembly, a high performance liquid chromatograph (HPLC), and an atomic absorption (AA) spectrometer. This instrumentation is being used to update the curriculum in the undergraduate laboratories by providing students hands-on experience with analytical techniques where lecture presentations have often sufficed in the past. A major curriculum component being developed is that involving the role of the computer in data acquisition and treatment, with important applications in Instrumental Analysis as well as in the Physical and Honors General Chemistry laboratory courses.

Leon S. Yengoyan  
San Jose State University  
San Jose, CA

CSI 8750906  
\$29,116

#### **"Introduction of Gas Chromatography—Mass Spectrometry (GC/MS) into the Undergraduate Chemistry Curriculum"**

The recent acquisition of a gas chromatograph/mass spectrometer (GC/MS) system (including a computer-con-

trolled work station) by the Chemistry Department at San Jose State University is providing undergraduate students with a hands-on working experience in a modern and powerful analytical technique vital for training the modern chemist in such fields as organic and analytical chemistry, toxicology, forensics, and environmental sciences. Extensive use of the system occurs in a new Separation Science Course, with additional use in the organic and biochemistry laboratories, as well as in undergraduate research, resulting in significant enhancement of the chemistry curriculum.

Nathan W. Bower  
Colorado College  
Colorado Springs, CO

CSI 8750040  
\$25,830

#### **"Integrated Chemometrics Program for the Undergraduate Curriculum"**

Chemometrics has been defined as the field in which mathematical and statistical techniques are used to extract valuable, but often hidden, information from measurements. Its introduction into the undergraduate curriculum has been recommended by the American Chemical Society. The Chemistry Department at Colorado College is implementing the introduction of chemometrics into the undergraduate curriculum through the recent acquisition of a Fourier Transform Infrared Spectrometer with selected spectral libraries and an enhanced library search package attachments. In addition to the usual infrared spectroscopy activities, use of this system is providing students with experiences in fourier transforms and computerized spectral searches. The courses impacted include organic chemistry, quantitative analysis, advanced analytical topics, reaction mechanisms and syntheses, theoretical spectroscopy, and research participation.

Melvin L. Druelinger  
University of Southern Colorado  
Pueblo, CO

CSI 8750177  
\$36,456

#### **"Introduction of Fourier Transform-Infrared Spectroscopy (FT-IR) into the Chemistry Curriculum and Integration with Computer-Controlled Gas Chromatography"**

The introduction of Fourier Transform Infrared Spectroscopy, integrated with computer-controlled Gas Chromatography, into the undergraduate chemistry curriculum at the University of Southern Colorado has provided a major tool for introducing students to the use of computer integrated instrumentation, database searching and computer assisted data manipulation. The combination of GC with FTIR allows students hands-on experience with a system

dealing with real world complex microanalysis problems as practiced in industry and research. Diffuse reflectance and cylindrical internal reflectance accessories allow students to explore most modern sampling techniques. Courses directly impacted include Organic Chemistry, Physical Chemistry, Instrumental Analysis, Advanced Organic Chemistry and Independent Study. Both majors and non-majors are exposed to this instrumentation.

Richard V. Prigodich  
Trinity College  
Hartford, CT

CSI 8750507  
\$50,000

#### **"Undergraduate Instruction in FT-NMR"**

The use of nuclear magnetic resonance to study molecular structure and dynamics is common in academic and industrial research programs and FT-NMR is the state-of-the-art choice for such studies. A recently acquired 200 MHz FT-NMR spectrometer is being used in a variety of upper level courses for chemistry and biochemistry majors at Trinity College, allowing an existing Varian T-60 to be used in the introductory organic chemistry laboratory.

Harold T. McKone  
St Joseph College  
West Hartford, CT

CSI 8750142  
\$31,585

#### **"Incorporation of New NMR Applications in the Undergraduate Chemistry Curriculum"**

A 60-MHz Nuclear Magnetic Resonance Spectrometer with variable temperature, spin decoupler, and fluorine observation accessories is being used in courses in organic, physical, biochemistry, instrumentation and student research at St. Joseph College. A variety of new student experiments are being developed. For example: the study of conformational and keto-enol equilibria with the variable temperature accessory; the simplification of complex spectra using the decoupling accessory; and inorganic NMR applications through fluorine-19 observations.

Brian G. Ramsey  
Rollins College  
Winter Park, FL

CSI 8750373  
\$20,800

#### **"Fourier Transform Infrared Spectroscopy in the Chemistry Curriculum at Rollins College"**

The acquisition of a computerized Fourier Transform Infrared (FTIR) Spectrophotometer by the Chemistry Department of Rollins College is significantly improving un-

dergraduate instruction by making possible the addition of several new experiments to the laboratory curriculum. The new system increases the efficiency with which principles of spectroscopy are taught in organic and inorganic chemistry courses; students are able to quickly characterize and identify unknown compounds or products from synthetic reactions. Finally, students receive instruction incorporating the use of a modern analytical instrument with computerized data acquisition and manipulation.

Theodore W. Beiler  
Stetson University  
Deland, FL

CSI 8750720  
\$6,974

#### **"Instrumentation in the Microscale Organic Laboratory"**

Instrumentation appropriate for use in a microscale organic laboratory has been recently acquired by the Chemistry Department at Stetson University. This includes toploading electronic balances for rapid and accurate weighing of milligram quantities, an infrared spectrophotometer for identification of small quantities, a recorder for a gas chromatograph to provide rapid analysis of volatile samples, and a refractometer for rapid assay of liquid fractions. Conversion of the laboratory to microscale increases student efficiency in laboratory operation, permits more sophisticated laboratory reactions, increases the number of experiments, increases the interest in and retention of principles, markedly cuts the annual expense for chemicals and glassware, and decreases laboratory air pollution and the amount of toxic chemical waste disposal.

Clifford W. Chang  
University of West Florida  
Pensacola, FL

CSI 8750196  
\$25,708

#### **"Mass Spectrometry as an Instructional Tool in the Undergraduate Laboratories"**

A gas chromatograph/mass spectrometer (GC/MS), which has recently been acquired by the Chemistry Department of the University of West Florida is finding application in six undergraduate courses and in directed student research. Courses in basic organic chemistry, with a variety of majors, and advanced organic chemistry, with chemistry and allied health science majors are significantly enhanced by the availability of this system. Students are enabled to collect and evaluate firsthand data as, for example, (1) separating and identifying halocarbons by examining the molecular ions formed, (2) differentiating between isomers such as methyl p-hydroxybenzoate and p-methoxybenzoic acid by examining the fragmentation ions, (3) preparing and ana-

lyzing volatile organometallics, and (4) evaluating water supplies for organic contaminants.

Robert A. Pierotti  
Georgia Institute of Technology  
Atlanta, GA

CSI 8750927  
\$50,000

#### **"Effective Utilization of Chemical Instrumentation in Undergraduate Instruction: A Regional Approach"**

This project is continuing and expanding an effort, begun several years ago, to provide maintenance and repair service for chemical instrumentation at undergraduate institutions in the southeast. The service is provided by trained electronic personnel working from a mobile van outfitted as an electronics shop, and includes repair, maintenance, calibration, and consultative instruction among the offerings available. In the history of operation to date, 84 undergraduate institutions in Alabama, Florida, Georgia, North Carolina, South Carolina and Tennessee have been involved and over 3000 instruments have been serviced and calibrated. It is anticipated that 50 colleges and universities and over 5000 students will be affected each year by this project. Institutions served include a number of colleges for minorities and women.

Troy L. Story, Jr.  
Morehouse College  
Atlanta, GA

CSI 8750001  
\$45,648

#### **"Multi-Course Instrumentation Laboratory"**

A multi-course instrumentation laboratory has been established in the Chemistry Department at Morehouse College. This laboratory includes equipment for the instrumental part of a traditional undergraduate chemistry laboratory together with a laser laboratory and a computer laboratory. Courses have been modified to include the use of computer-interfaced spectroscopic equipment with appropriate software for data analysis, laser-based experiments, and computer-based instruction devoted to solving chemical problems with the type of software found in modern academic and industrial settings. Majors in chemistry, biology, and physics, and students pursuing careers in the health and engineering professions are impacted by the activities of this facility. Since Morehouse is the only one of four colleges in the Atlanta University Center Consortium which offers all of the upper division courses required of chemistry and pre-engineering majors, these activities represent a unifying effort embracing students at four undergraduate institutions.



Arthur L. Mori  
Chaminade University of Honolulu  
Honolulu, HI

CSI 8750869  
\$26,550

#### **"NMR in Undergraduate Chemistry Curriculum"**

The recent acquisition of a nuclear magnetic resonance (NMR) spectrometer by the Physical Science Department of Chaminade University of Honolulu is improving the undergraduate laboratory and directed research experience of undergraduate students. Freshmen and sophomores use the NMR spectrometer under close supervision; juniors and seniors use it on a regular basis for laboratory work and directed research. Nine different chemistry courses are affected, ranging from the introduction of NMR theory in the general chemistry course to detailed study and experimentation and research in the advanced chemistry courses.

Stanley R. Watkins  
Coe College  
Cedar Rapids, IA

CSI 8750159  
\$9,111

#### **"Computer Interfaced UV/Visible Spectrophotometry for the Chemistry Undergraduate"**

The versatile instructional experiences which modern, computer-interfaced spectrophotometers make possible are now available to undergraduate students in chemistry at Coe College. A photodiode ultraviolet-visible spectrophotometer has been recently acquired, which when suitably configured with a personal computer, affords students opportunities to perform experiments utilizing the latest advances in spectrophotometry. The capacity to recall archived data and use third party software to design spreadsheets for performing calculations and plotting spectral data is of pedagogic value in advanced courses that include the study of kinetics, coordination compounds, and the quantitative analysis of complex mixtures.

Richard Biagioni  
Grinnell College  
Grinnell, IA

CSI 8750712  
\$23,987

#### **"Fourier Transform Infrared Spectrophotometer System"**

A Fourier Transform infrared (FTIR) spectrophotometer system, with moderately high resolution and sufficient computer power to allow sophisticated data analysis, has recently been acquired by the Chemistry Department of Grinnell College. A spectral data base and an attenuated total reflectance sampling accessory are integral parts of

the system. A major impact of this acquisition is in the Instrumental Analysis course where extensive data manipulation, data base searching, quantitative analysis and low light techniques will be a major emphasis. In addition, the system is used in other upper division courses, particularly in the ongoing active student research program, and in the Physical Chemistry laboratory for obtaining and analyzing high resolution spectra of gases.

Carolyn Mottley  
Luther College  
Decorah, IA

CSI 8750016  
\$38,000

#### **"Improving Undergraduate Instruction Through Applications of Nuclear Magnetic Resonance Spectrometry"**

A recently acquired Nuclear Magnetic Resonance Spectrophotometer is being used in undergraduate instruction in organic, inorganic, physical, and analytical/instrumental chemistry at Luther College. This instrument system, with its enhanced resolution and variable temperature capability allows students first hand experience in the study of molecular structure, stereochemistry, reaction kinetics and thermodynamics.

Zafra M. Lerman  
Columbia College  
Chicago, IL

CSI 8750193  
\$20,653

#### **"Instrumentation for Undergraduate Instruction in Chemistry for Science, Technology and Communications"**

Modern instrumental techniques including ultraviolet-visible spectroscopy, infrared spectroscopy and gas chromatography are being used by the Chemistry Department at Columbia College for the undergraduate instruction of students majoring in the communications professions. The theme of science, technology, and communications provides a focus for instruction in basic science which is integrated with the students' communication specialties through the preparation of videotapes or films on individual research projects. A project objective is that students, in their future careers in communications, will be able to use their scientific training to report more effectively to the public on matters of science and technology.

Homer A. Smith, Jr.  
Millikin University  
Decatur, IL

CSI 8750853  
\$16,489

#### **"Modern Instrumentation for Project-Based Undergraduate Chemistry Laboratories"**

For the optimum operation of a new project-based sophomore-junior chemistry laboratory program at Milliken

University, the recent acquisition of a diode-array spectrometer, a gas chromatograph with integrator, and two microcomputers provides students with the speed and versatility needed to make fast, accurate measurements and to process data efficiently. In these laboratory activities, which have been transformed into separate courses with an emphasis on experiments rather than exercises, the objective is for students to develop maximum independence so that the difficulty often encountered in making the transition into industrial careers or graduate training can be minimized.

Janos Szamosi  
Western Illinois University  
Macomb, IL

CSI 8750029  
\$22,268

#### **"Development of a Computational Chemistry Laboratory"**

A computational chemistry course has been recently approved at Western Illinois University. To implement this curricular addition, 10 microcomputers with associated software are now available for student use in that course, and in addition are being used for data acquisition, storage, and analysis in other chemistry courses: instrumental analysis, physical chemistry, advanced inorganic chemistry, and junior and senior research projects. The major goal of this effort is to thoroughly integrate microcomputers into the chemistry curriculum.

David T. Harvey  
DePauw University  
Greencastle, IN

CSI 8750039  
\$21,995

#### **"Modernizing the Undergraduate Instrumental Analysis Laboratory"**

Undergraduate chemistry majors at DePauw University are being provided with routine access to a significant number of modern instrumental techniques in the areas of spectroscopy, separations, and electrochemistry. A number of modern instruments have been recently acquired: cyclic voltammograph, gas chromatograph, atomic absorption spectrophotometer, ultraviolet-visible spectrophotometer, which coupled with existing departmental instrumentation, have allowed the development of a new laboratory curriculum in Instrumental Analysis. This course has an emphasis on methods for instrumental optimization, methods of data collection and analysis, and methods for studying chemical reactions and reaction mechanisms.

Gerald R. Bakker  
Earlham College  
Richmond, IN

CSI 8750543  
\$7,800

#### **"Undergraduate Instructional Use of a Diode Array UV/VIS Spectrophotometer"**

The recent acquisition of a diode array ultraviolet-visible (UV/VIS) spectrophotometer, interfaced with a computer, is allowing undergraduate students in the Chemistry Department at Earlham College to develop a familiarity and competence with modern computer-controlled instrumentation. The system has the capability to collect data rapidly under a variety of circumstances and to manipulate and graph the data in various ways. Spectral analyses of metal complexes, chemical kinetics in biochemical systems, detector use in chromatographic separations, and use in independent study are among the applications of the system which students will explore.

Edward J. Kelly  
Marion College  
Marion, IN

CSI 8750289  
\$9,180

#### **"Integration of the Use of an NMR Spectrometer in an Undergraduate Chemistry Program"**

Integration of nuclear magnetic resonance spectroscopy into the chemistry curriculum at Marian College provides students with an opportunity to put NMR principles into practice through "hands-on" experience, in class projects and in independent research. The use of NMR spectroscopy in Organic Chemistry, Organic Qualitative Analysis, Physical Chemistry, Instrumental Analysis and Independent Research complements student use of infrared and ultraviolet-visible spectroscopy, chromatographic techniques and electrochemical applications.

Frank A. Guthrie  
Rose-Hulman Inst. of Tech.  
Terre Haute, IN

CSI 8750501  
\$9,300

#### **"Undergraduate Laboratory Instruction in Electrochemistry"**

A microprocessor-controlled electrochemical system has been recently acquired by the Chemistry Department of Rose-Hulman Institute of Technology, allowing the use of this instrumentation for a number of applications in analytical, inorganic, and organic chemistry. These include a convenient and logical examination of electrode processes via the oxidation of various organic molecules in the cyclic voltammetry mode, enhanced ability to determine trace

levels of ions via stripping and square wave techniques, and the availability of a new and powerful way to introduce students to free radical organic chemistry. Undergraduate students in analytical chemistry compare various analysis methods, and investigate indicator blockage by transition metal cations in EDTA titrations, whereas undergraduates in inorganic courses study catalytically active substances and carry out small-scale electrochemical syntheses.

Pamela L. Plouhar  
St Mary's College  
Notre Dame, IN

CSI 8750481  
\$27,380

#### **"Development of the Undergraduate Biochemistry Laboratory"**

The Department of Chemistry and Physics at St. Mary's College is upgrading the biochemistry offerings in the curriculum. A major thrust is the development of a biochemistry laboratory which emphasizes both the basic concepts presented in the associated lectures, and introduces the student to the techniques commonly used in the discipline. The recent acquisition of a high speed centrifuge, two ultraviolet-visible (UV/VIS) spectrophotometers, electrophoretic equipment, a tissue homogenizer, and an oxygen electrode has allowed the laboratory content to be significantly upgraded. Innovative laboratory courses which provide exposure to a number of fundamental biochemical techniques are now available, affording students better opportunities to apply their knowledge of chemistry to biological systems.

Stanley L. Burden  
Taylor University  
Upland, IN

CSI 8750172  
\$22,195

#### **"High Performance Liquid Chromatography/Ion Exchange Chromatography at Taylor University"**

High performance liquid chromatography/ion chromatography instrumentation is being used in laboratory activities in organic chemistry, analytical chemistry, biochemistry, environmental chemistry, advanced laboratory and student directed research in the Chemistry Department at Taylor University. Concepts currently taught are reinforced by these experiences and the range and sophistication of applications is enhanced.

Mike L. Mitchell  
Bethany College  
Lindsborg, KS

CSI 8750702  
\$26,350

#### **"Improvement of Undergraduate Chemistry Curriculum by Addition of an NMR Spectrometer"**

Undergraduate chemistry instruction has been enhanced at Bethany College by the acquisition of a nuclear magnetic

resonance spectrometer. Students are provided with opportunities to obtain real spectra of synthesis products and to study chemical phenomena such as metal ion complexation and acid-base equilibria. This acquisition is part of a five year plan by the Chemistry Department to improve laboratory instrumentation.

Jeffrey H. Baxter  
Eastern Kentucky University  
Richmond, KY

CSI 8750036  
\$32,847

#### **"Update of Equipment Used in Undergraduate Biochemistry Labs"**

The Chemistry Department at Eastern Kentucky University has recently acquired the equipment needed to develop and implement modern, instrumentation-oriented laboratory courses in biochemistry. This equipment (which represents the basic tools of the biochemist) includes spectrophotometers, a high-speed centrifuge (used in almost every phase of biochemistry), and electrophoretic apparatus (used in the characterization and purification of many types of large molecules). The use of this instrumentation, together with other important equipment such as clinical centrifuges (for applications not requiring high speed), and chart recorders (to record data on a continuous basis), affords students excellent laboratory experiences in biochemistry and provides them with better preparation for advanced study.

Arlene R. Courtney  
Murray State University  
Murray, KY

CSI 8750472  
\$50,000

#### **"Integration of Multinuclear Magnetic Resonance Spectroscopy into a Modern Chemistry Laboratory Program"**

The addition of a broad band Fourier Transform Nuclear Magnetic Resonance (FTNMR) system to the instrumentation available in the Chemistry Department at Murray State University is allowing the introduction of the theory and practice of multinuclear FTNMR into the undergraduate chemistry curriculum. Initial use of the system begins in the first semester organic laboratory course, with increased utilization thereafter in second semester organic, as well as in subsequent upper division laboratory courses. These include physical chemistry, inorganic laboratory, instrumental analysis, and spectrometric identification, as well as undergraduate research.



Thomas J. Wenzel  
Bates College  
Lewiston, ME

CSI 8750027  
\$27,710

#### **"Gas Chromatograph Mass Spectrometer for Undergraduate Instruction"**

A gas chromatograph/mass spectrometer (GC/MS) is being used by the Chemistry Department at Bates College for undergraduate instruction beginning in the sophomore year with organic chemistry and continuing in varying degrees in five upper-level chemistry courses. The specific applications of GC/MS in these courses has been designed to be similar to those encountered by industrial chemists or by students undertaking graduate study.

James R. Locker  
Washington College  
Chestertown, MD

CSI 8750059  
\$5,235

#### **"A Polarographic Analyzer System for Undergraduate Laboratories and Student Research"**

A Polarographic analyzer system is being used by the Chemistry Department at Washington College to provide students with extensive "hands on" experience using modern voltammetric methods in analytical chemistry courses. This instrumentation is also being used in student research projects, one of which is concerned with the effects on marine species of increased zinc and aluminum concentrations in the Chesapeake Bay. A forensic chemistry course offered each spring to advanced high school students also utilizes polarographic methods.

George A. Vidulich  
College of the Holy Cross  
Worcester, MA

CSI 8750477  
\$50,000

#### **"Improvement in Advanced Laboratory Using an Instrumental Laboratory Timesharing Concept"**

Teaching undergraduates to use modern chemical instrumentation has become increasingly difficult due to the sophistication and complexity of both the instruments and the theory upon which they are based. This situation has aggravated the problem of scheduling experiments at the most opportune time. A unique plan to overcome these difficulties is being implemented by the Chemistry Department of the College of the Holy Cross by merging the Physical Chemistry and Instrumental Analysis Laboratories into a coherent threesemester advanced laboratory program. An orderly progression from basic instrumental laboratory techniques in the first semester to challenging and

advanced topics in the third semester is being followed. During the first semester a unique timesharing approach, utilizing the rapid data acquisition capabilities of an ultraviolet-visible (UV-VIS) rapid scan spectrophotometer and a Fourier Transform Infrared (FTIR) spectrophotometer, makes it possible for all students to concurrently carry out a series of introductory experiments in spectroscopy. During the same semester they will be introduced to the use of the computer as a data station. The culmination of the students' laboratory experience occurs in the third semester where they devote attention to projects centered around some of the challenging and advanced techniques essential to carrying out modern chemical research, including the use of lasers in chemistry, techniques for studying very fast reactions, and microcomputers.

Abha Sur  
Mount Holyoke College  
South Hadley, MA

CSI 8750925  
\$21,725

#### **"Instrumentation for the Physical Chemistry Laboratory"**

The recent acquisition of a Fourier Transform Infrared Spectrophotometer is enabling the Chemistry Department at Mount Holyoke College to significantly expand the scope and sophistication of the laboratory curriculum in physical chemistry, in a methods of measurement course, in micro-scale organic chemistry and in independent research.

Chang-Ning Wu  
Southeastern Mass. Univ.  
North Dartmouth, MA

CSI 8750943  
\$14,934

#### **"The Use of a Computer-Interfaced Differential Scanning Calorimeter in the Undergraduate Laboratory: A Class-Project Oriented Program"**

A computer-interfaced Differential Scanning Calorimeter is being used in the polymer chemistry laboratory course for advanced undergraduates in chemistry and textile chemistry at Southeastern Massachusetts University. A class project orientation is used in which students prepare a series of liquid crystal polymers with different structures. Characterization data is obtained using the calorimeter and students pool their results to reach conclusions on structure/property relationships.

Willard L. Craft  
Adrian College  
Adrian, MI

CSI 8750399  
\$29,630

#### **"Increased Access to High Quality NMR Spectra"**

A computer-interfaced Nuclear Magnetic Resonance Spectrophotometer together with a computer-controlled

Spectral Bulletin Board are being used by the Chemistry Department at Adrian College to achieve the following goals: provide Adrian students with access to high quality NMR spectra for spectral interpretation, quantitative analysis of mixtures and reaction rate determinations; and provide access to high quality NMR spectra for faculty and students at other schools throughout the nation. These spectra are available either by sending diskettes through the mail or by telephone access using modems to the Adrian Spectral Bulletin Board.

Robert E. Dininny  
Albion College  
Albion, MI

CSI 8750716  
\$34,435

#### **"Instrumentation for an Integrated Undergraduate Laboratory Program"**

The Chemistry Department at Albion College has based its efforts in curriculum development and the preparation of instructional materials on the premise that a chemistry curriculum should: (1) be designed for the specific students it serves; (2) serve majors and non-majors equally well; (3) provide maximum flexibility; (4) reflect current practice in chemistry and chemical education at all levels of the curriculum, both in the classroom and the laboratory. Current laboratory practice dictates the involvement of students with modern instrumentation, an outcome which is being enhanced by the recent acquisition of a nuclear magnetic resonance (NMR) spectrometer. This instrument is being utilized by students in laboratory courses in organic chemistry, advanced laboratory instrumentation, and advanced laboratory projects. In addition the availability of the NMR broadens the range of possibilities for student research projects.

John W. Moore  
Eastern Michigan University  
Ypsilanti, MI

CSI 8750324  
\$38,464

#### **"Modernization of the General Chemistry Laboratory by Integration of Computer-Based Experiments"**

The Chemistry Department at Eastern Michigan University has recently acquired twenty four microprocessors together with sufficient software so that computer-based experiments can be integrated into the general chemistry laboratory. The applications of computers being introduced include interfacing to instrument/sensors for instrument control and data acquisition, simulating inaccessible experiments and atomic-level phenomena, and exploring a chemical database and mathematical models. Utilization

of the computers in the laboratory will be continued as students proceed to upper-level courses.

Michael J. Brabec  
Eastern Michigan University  
Ypsilanti, MI

CSI 8750458  
\$26,490

#### **"Equipment for Undergraduate Instruction in Toxicology"**

Three high performance liquid chromatographs (HPLCs), a Biological Oxygen Monitor (BOM), and a DNA filter elution system (spectrofluorometers and peristaltic pumps), recently acquired by the Chemistry Department at Eastern Michigan University, provide undergraduate students with opportunities to utilize cellular and biochemical technology to study the interactions between chemicals and living systems. HPLC is being used to study the formation of metabolites and identify molecular adducts resulting from exposure to toxic chemicals. The DNA filter elution system allows students to examine changes in DNA integrity introduced by exposure to chemical carcinogens and mutagens. The BOM is being used in the study of sub-cellular reactions to toxic chemicals. In particular, activities are directed toward the developing field of toxicology, with a focus on understanding basic biochemical and cellular phenomena as well as determining the hazards associated with exposure to toxic levels of chemicals.

Peter J. Moehs  
Saginaw Valley State College  
University Center, MI

CSI 8750521  
\$34,500

#### **"Improving Undergraduate Laboratory Instruction in Chemistry Through the Use of Energy Dispersive X-Ray Fluorescence Spectroscopy"**

The recent acquisition of an energy dispersive x-ray fluorescence (EDXRF) spectrometer allows this instrument to be used in the analytical/physical course sequence in chemistry at Saginaw Valley State College. Students have an opportunity to demonstrate the character of atoms through generation of line spectra, to show the relationship between x-ray photon/electron interactions using Compton shift and other effects relating to absorption edges, absorption and photoelectric effects. Since EDXRF is a rapid, non-destructive technique, students who carry out experiments utilizing this instrument acquire up-to-date qualitative and quantitative analytical techniques and a basic understanding of atomic structure and the properties of x-rays, required to enter their respective scientific fields.

Jerry R. Mohrig  
Carleton College  
Northfield, MN

CSI 8750210  
\$33,472

**"Improving Undergraduate Instruction in Chemistry Through the Use of a Gas Chromatograph/Mass Selective Detector System"**

A recently acquired, versatile, state-of-the-art gas chromatograph/mass selective detector (GC/MSD) is now being used in the undergraduate chemistry program at Carleton College. Direct student access to this sophisticated microcomputer-controlled instrument provides powerful motivation for students to follow careers in science. The system is used in both upper-level and introductory-level courses, including the junior-year integrated laboratory sequence, undergraduate research projects, organic chemistry, and the introductory chemistry laboratory. A significant fraction of the chemistry majors at Carleton are women.

Theresa A. Salerno  
Mankato State University  
Mankato, MN

CSI 8750845  
\$22,274

**"Development of Biochemistry Laboratory Curriculum"**

The Department of Chemistry and Geology at Mankato State University has recently acquired a high speed centrifuge and a liquid scintillation counter for use in the improvement of undergraduate instruction in biochemistry. The major objective is to revitalize the biochemistry program by implementing a senior level "project oriented" laboratory course. In this course, students learn to work as a team to solve a specific research problem involving the characterization of a plant RNA virus. The students design an experimental strategy to solve the assigned problem including learning how to use the literature, planning and organizing experiments, performing a wide range of preparative and analytical biochemical techniques, and interpreting and communicating data.

George L. Hardgrove, Jr.  
St. Olaf College  
Northfield, MN

CSI 8750342  
\$29,278

**"Polymer Chemistry in the Physical Chemistry Laboratory Using a Differential Scanning Calorimeter and Gel Permeation Liquid Chromatography Equipment"**

The inclusion of more polymer chemistry in the standard physical chemistry laboratory course is among the added

capabilities provided by the recent acquisition of a differential scanning calorimeter and gel permeation liquid chromatography equipment at St. Olaf College. Gel permeation is being used to determine the molecular weight distribution of polymers while phase changes in polymers are being studied via differential scanning calorimetry. These experiments are complemented by a study of copolymer composition using NMR and Fourier Transform Infrared Spectroscopy.

J. Paul Hollomon  
Delta State University  
Cleveland, MS

CSI 8750608  
\$12,580

**"Enhancement of General Chemistry through a Microcomputer Laboratory for Tutorial Work and Data Analysis"**

A microcomputer laboratory consisting of eight microcomputers and associated software is being used in the general chemistry program at Delta State University for tutorial work and data analysis. Computer assisted instruction, in this setting, is being used to provide challenging experiences for advanced students and remedial work for those with educational deficiencies.

John W. Legg  
Mississippi College  
Clinton, MS

CSI 8750248  
\$7,076

**"Modern Gas Chromatography for an Instrument-Oriented Chemistry Program"**

A computer controlled capillary gas chromatograph is being used by the Chemistry Department at Mississippi College for undergraduate instruction in organic, analytical, instrumental, and physical chemistry. Use of this instrumentation is correlated with that of other computer interfaced analytical instrumentation available in the department. There is a central focus on instruction in the theoretical and practical aspects of modern separation science.

Vernon J. Thielmann  
Southwest Missouri State Univ  
Springfield, MO

CSI 8750708  
\$50,000

**"Strengthening Undergraduate Organic and Analytical Chemistry—NMR"**

As part of a three year departmental plan to improve undergraduate instruction, the Chemistry Department of Southwest Missouri State University has recently acquired



a multinuclear, variable temperature 90MHz nuclear magnetic resonance spectrometer. This instrument is being used in courses in organic chemistry, organic qualitative analysis, physical chemistry, molecular spectroscopy, and biochemistry, with particular emphasis on its use in the interpretation of  $^{13}\text{C}$  NMR spectra. The availability of the new NMR system is also providing for additional undergraduate research projects in organic chemistry, biochemistry, polymer chemistry, analytical chemistry, and physical chemistry.

Dale E. Vitale  
Kean College of New Jersey  
Union, NJ

CSI 8750267  
\$30,850

#### **"An Integrated Approach to the Teaching of NMR Methods at the Undergraduate Level"**

The applications of nuclear magnetic resonance (NMR) spectroscopy to both "static" investigations like the elucidation of molecular structure and to "dynamic" ones like the measurement of the rates of physical and/or chemical processes illustrates the versatility and utility of NMR in spanning the chemical disciplines from organic to inorganic chemistry. The recent acquisition of a continuous wave NMR spectrometer by the Chemistry Department at Kean College of New Jersey allows the application of these techniques in an integrated and cohesive way across the curriculum, thus providing the students, twenty four per cent of whom are minorities, with invaluable training and an intellectually stimulating theme in their scientific education.

Dan R. Bruss  
Albany College of Pharmacy  
Albany, NY

CSI 8750088  
\$31,700

#### **"Application of NMR Instrumentation in the Undergraduate Pharmacy Curriculum"**

The Physical Science Department of the Albany College of Pharmacy has significantly enhanced its instrumental holdings by the recent acquisition of a nuclear magnetic resonance (NMR) spectrometer. The availability of this system is providing undergraduate students in pharmacy (forty per cent of whom are women) with practical experience in using NMR spectroscopy in several courses, including introductory organic chemistry, honors organic chemistry, drug analysis, and undergraduate research.

Joseph F. Bieron  
Canisius College  
Buffalo, NY

CSI 8750139  
\$22,291

#### **"Chemical Separations and Microscale Syntheses"**

Sophisticated methods of separation by gas chromatography with component identification by mass spectrometry,

routine in the chemical profession, is now included in the undergraduate laboratory experiences in chemistry at Canisius College. An integral part of this development has been the acquisition of a gas chromatography/mass spectrometry system which, as a key component of, and in conjunction with existing instrumentation-FTIR, NMR, UV-Visible, HPLC, etc., is being used to develop new laboratory experiences in separations and microscale organic and inorganic syntheses. The microscale approach to chemical syntheses is very attractive because of shorter reaction times, faster work-up procedures, greater laboratory safety, and facile chemical waste disposal.

Reuben L. Baumgarten  
CUNY Herbert L. Lehman College  
New York, NY

CSI 8750789  
\$36,216

#### **"Improvement of Instrument Based Instruction in Chemistry"**

The recent acquisition of a state-of-the-art nuclear magnetic resonance spectrophotometer (Varian EM 360L) is enabling the chemistry department at CUNY Lehman College to implement major curriculum revisions in the organic chemistry laboratory courses, to introduce important NMR-based experiments in physical chemistry, instrumental analysis, and biochemistry, and to enhance student learning in undergraduate research. Since the undergraduate enrollment at this institution is predominantly minority, these revisions will significantly affect undergraduate instruction for this group which has been traditionally underrepresented in science, mathematics and engineering.

Jerome S. Levkov  
Iona College  
New Rochelle, NY

CSI 8750953  
\$26,546

#### **"NMR Spectroscopy: Course Revision, Interfacing and Dissemination for Undergraduate Instruction"**

In this project, Nuclear Magnetic Resonance Spectroscopy is being used by biology, biochemistry, and chemistry majors at Iona College as a qualitative and quantitative tool, and as a probe for making fundamental physical and chemical measurements to enhance understanding of the theoretical and practical applications of this method to undergraduate instruction. As an exercise in practical electronics, students interface a personal computer with the NMR spectrometer using general purpose, commercially available hardware and software.

Donald W. Rogers  
Long Island Univ Brooklyn Campus  
New York, NY

CSI 8750827  
\$7,116

#### **"Microcomputer Interfacing and Microelectronics"**

At Long Island University, Brooklyn Center, students in chemistry, biology, physics, science education and pharmacy are gaining added experience in constructing interfaces between laboratory instruments and microcomputers, through the recent acquisition of twelve state-of-the-art microcomputers together with appropriate monitors, printers, plotters, and interfacing breadboards. This is being accomplished in ongoing classes specifically devoted to such interfacing activities where students receive instruction in microcomputer interfacing and programming for controlling and gathering data from laboratory instruments.

Karen S. Quaal  
Siena College  
Loudonville, NY

CSI 8750540  
\$21,890

#### **"Modern IR and UV/VIS Spectrophotometry in the Undergraduate Chemistry Curriculum"**

Infrared (IR) and ultraviolet-visible (UV/VIS) spectroscopy are crucial methods for the current understanding of chemical structure and reaction mechanisms. The use of two such spectrophotometers, recently acquired by the Chemistry Department at Siena College, is providing students with knowledge of the theoretical basis of these methods and experience with state-of-the-art techniques for data retrieval and analysis. Together with a data station which is shared by the two instruments, and selected software, the laboratory sections of all of the upper level chemistry courses are impacted by the use of this integrated system. These courses include Organic Chemistry, Physical Chemistry, Instrumental Methods, Synthesis and Characterization, and Independent Research.

Stephen D. Williams  
Appalachian State University  
Boone, NC

CSI 8750809  
\$20,050

#### **"Gas Chromatography/Mass Spectrometry in an Undergraduate Chemistry Curriculum"**

The Chemistry Department at Appalachian State University has recently acquired an ion trap mass spectrometer and a microcomputer system which when interfaced with a gas chromatograph affords undergraduate students opportunities to expand their experience with modern instrumentation. Student use of this system is an integral part

of a course in natural products chemistry, and one devoted to the use of computerized instrumentation. In addition, the instrument is used in introductory courses as a lecture demonstration tool and as a qualitative and quantitative tool in the organic chemistry laboratory.

Felix A. Carroll  
Davidson College  
Davidson, NC

CSI 8750021  
\$9,921

#### **"Improving Undergraduate Instruction in Chemistry Through the Use of a Photodiode Array Ultraviolet-Visible Spectrophotometer"**

The recent acquisition of a photodiode array ultraviolet-visible spectrophotometer is being used in the teaching of chemical principles and laboratory techniques to chemistry majors, other science majors and premedical students, and non-science majors at Davidson College. The speed of the instrument allows complete spectra to be acquired within seconds, displayed on a monitor, stored on disk, mathematically manipulated, and printed. The instrument is being used for kinetic experiments that require absorption values at more than one wavelength to be measured simultaneously. It also serves as a detector for high performance liquid chromatography, thus introducing students to principles of chromatography-spectrophotometry. Chemistry majors study the principles of operation of this computer-controlled instrument, with emphasis on concepts of digital electronics, instrument control, data file structures, and data transfer operations. The instrument is also used in student research projects involving organic photochemical reactions, the characterization of transition metal complexes, and investigation of the function of proteins.

William A. Hoffman, Jr.  
Thomas A. Evans  
Denison University  
Granville, OH

CSI 8750741  
\$21,150

#### **"FTIR Instrumentation for Undergraduate Instruction"**

The development of Fourier Transform Infrared (FTIR) Spectroscopy has transformed the investigation and characterization of materials by infrared spectroscopy. The recent acquisition of FTIR instrumentation by the Chemistry Department at Denison University is providing undergraduate students with experience in the qualitative and quantitative applications of FTIR at all levels of the curriculum. The instrument's superior resolution, output flexibility, and capacity for searching spectral data bases allows students to work on problems ranging from polymer film analysis

by non-science students to the characterization of novel oxidized porphyrins by senior research students.

Norman C. Craig  
Oberlin College  
Oberlin, OH

CSI 8750723  
\$19,300

#### **"Purchase of a Fourier-Transform Infrared Spectrometer"**

A recently acquired Fourier Transform Infrared Spectrometer (FTIR) is being used in the undergraduate chemistry curriculum at Oberlin College. This powerful microcomputer-controlled instrument provides more rapid spectral analysis together with higher resolution than can be obtained even with a research-grade dispersive instrument. Seven courses and 150 students in upper and lower division classes will be directly impacted by the use of this FTIR.

Robert G. Wolcott  
Linfield College  
McMinnville, OR

CSI 8750192  
\$26,372

#### **"NMR in Undergraduate Instrumentation in Chemistry and Physics"**

The use of a recently acquired 60 MHz nuclear magnetic resonance (NMR) spectrometer with lock/decoupler and variable temperature accessories is modernizing and significantly broadening the training of undergraduate students in chemistry and other sciences at Linfield College. This is being accomplished through the implementation of six instructional objectives: (1) training students in the use of NMR to rapidly generate detailed information about the physical structure of small molecules; (2) helping students verify the identity of organic compounds synthesized in the laboratory; (3) providing a way to measure subtle temperature-dependent physical changes in molecules; (4) illustrating physical principles related to nuclear spin; (5) introducing students to a means of rapidly determining the relative quantities of known compounds in mixtures; (6) encouraging undergraduates to become involved in research projects.

John E. Hancock  
Reed College  
Portland, OR

CSI 8750840  
\$30,531

#### **"Acquisition of a FT-IR Instrument, and its Integration into Reed College's Chemistry Curriculum"**

A Fourier Transform Infrared Spectrometer is being used in a number of courses by the Chemistry Department at

Reed College to afford students a wider opportunity to utilize modern, state-of-the-art instrumentation in their undergraduate studies. Applications in both introductory and advanced organic, inorganic, physical, and instrumental chemistry together with a significant focus on undergraduate research are involved.

Helen M. Burke  
Chestnut Hill College  
Philadelphia, PA

CSI 8750633  
\$8,784

#### **"Quality Laboratory Instruction for the Undergraduate Chemistry/Biochemistry Major in Analytical Techniques and Research Capabilities"**

The recent acquisition of an Atomic Absorption (AA) Spectrometer by the Chemistry Department at Chestnut Hill College is significantly broadening the laboratory experience and improving the instruction of undergraduate students majoring in chemistry and biochemistry. The experience of working with an AA Spectrometer is of increasing importance to chemistry and biochemistry majors, whether they seek employment in analytical laboratories or plan to pursue further research in graduate school or industry. The introduction of this technique into advanced organic, biochemical, and instrumental courses ensures that the college's graduates receive the training necessary for careers as chemists and biochemists.

M. Bernice Andreleczyk  
Holy Family College  
Philadelphia, PA

CSI 8750597  
\$26,500

#### **"Improving Undergraduate Instruction in Organic Chemistry Through Proton NMR Spectrometry"**

A recently acquired NMR Spectrometer is being used extensively in the area of organic chemistry but also throughout the chemistry curriculum at Holy Family College in the preparation of students for industry, graduate school, teaching, pre-medicine, pre-pharmacy, medical technology and the allied health professions.

Dana P. McDermott  
Lafayette College  
Easton, PA

CSI 8750822  
\$19,200

#### **"FT-IR for Upper Division Undergraduate Chemistry Laboratories"**

A recently acquired Fourier Transform Infrared Spectrophotometer (FTIR) is being used in the laboratory pro-



grams in Analytical, Organic and Physical Chemistry at Lafayette College. Experiments hitherto not possible, such as analyses of residues in extracts from contaminated soils, studies of structural changes of compounds upon interaction with solvents, and studies of very rapid decomposition reactions, are being carried out. Contrasting the capabilities of FTIR with dispersive infrared spectrophotometry in these cases gives a deeper understanding of the inherent superiority of FTIR and of certain aspects of instrument development. In addition, the availability of FTIR is increasing student-faculty research activities, thus strengthening the professional training of chemistry majors. At Lafayette College, a large proportion of these are women.

David J. Cichowicz  
La Salle University  
Philadelphia, PA

CSI 8750760  
\$11,500

**"Incorporation of Fourier Transformation Methodology into La Salle University's Undergraduate Chemistry Curriculum"**

As a result of the massive technological reform which has taken place during the past ten years, virtually every academic and industrial research institution now obtains infrared spectra through the use of Fourier Transform instrumentation. To adequately prepare students who hope to pursue research-oriented careers, the Department of Chemistry at La Salle University has recently acquired a Fourier Transform Infrared (FTIR) Spectrophotometer which is being used by junior and senior chemistry majors as an integral part of four courses in the undergraduate curriculum: Advanced Quantitative (Instrumental) Analysis, Qualitative Organic Analysis, Advanced Inorganic Chemistry, and Senior Research. Through this experience, undergraduates are better able to understand the Fourier Transform method, learn how to perform peak searches in existing FTIR spectra libraries, and utilize IR spectroscopy as a quantitative technique.

Owen A. Moe, Jr.  
Lebanon Valley College  
Annville, PA

CSI 8750577  
\$22,890

**"The Introduction of a Gas Chromatograph/Mass Spectrometer into the Chemistry Curriculum to Strengthen Laboratory Instruction"**

A Gas Chromatograph/Mass Spectrometer with an interfaced computer-based data station is being used by the Chemistry Department at Lebanon Valley College in the following activities: A qualitative organic analysis experiment during the first semester of organic chemistry; Mea-

surement of reaction kinetics, determination of isotope exchange, and the determination of the fatty acid composition of natural fats in the second semester of organic chemistry; Demonstrating the principles of operation, and the analytical applications of GC/MS in an instrumental analysis course; Independent study, undergraduate summer research, and an annual summer chemistry program for advanced high school students.

Alan J. Jircitano  
Pennsylvania State University  
Behrend College  
Erie, PA

CSI 8750396  
\$7,431

**"An Ultraviolet-Visible Computing Spectrophotometer for Laboratory Courses and Undergraduate Research"**

In this project, a computer-interfaced diode array ultraviolet-visible spectrophotometer is being used by the Chemistry Department at Pennsylvania State University-Behrend College to enhance undergraduate instruction in analytical chemistry, inorganic chemistry, instrumental analysis, physical chemistry, and undergraduate research. Determination of the coordination number, geometry, and isomerization kinetics of transition metal complexes, rapid analytical measurements including analysis of Beer's Law deviations by second order comparisons with extensions to multicomponent analysis are experiments which the speed and data storage capabilities of this instrument make possible. Undergraduate research activities on iron-containing macrocyclic complexes and on the analysis and determination of wine phenols also utilize this sophisticated instrumentation extensively.

Suzanne P. Varimbi  
Rosemont College  
Rosemont, PA

CSI 8750834  
\$25,850

**"NMR Spectrometry for an Improved Undergraduate Chemistry Program"**

The quality of the chemistry program at Rosemont College has been enhanced by the recent acquisition of a nuclear magnetic resonance (NMR) spectrometer. The availability of this instrument is providing undergraduate students a broader experience with chemical phenomena and a realization of the potential of NMR as a powerful tool for further investigation. Implementation of these goals is accomplished in three steps: (a) introduction of the basic concepts of NMR spectrometry through experimentation followed by qualitative application to organic structure determination; (b) remodeling of the advanced laboratory

sequence to include a series of comparative experimental projects using NMR and other complimentary techniques, and (c) development of applications to undergraduate research projects.

Percy Warrick, Jr.  
Westminster College  
New Wilmington, PA

CSI 8750678  
\$5,300

**"Improvement of the Chemistry Advanced Laboratory Program Through the Addition of Differential Scanning Calorimetry"**

A modern differential scanning calorimeter is being used by upper level chemistry students at Westminster College to study the thermochemical properties of a variety of materials. The wide range of samples studied include polymers, liquid crystals, metal alloys, and the products from students' organic and inorganic synthesis projects. Students (forty per cent of whom are women) are gaining hands-on experience with this common testing method while investigating the physical nature of phase changes in condensed matter. Each student uses the equipment in at least six different projects, thus gaining a very thorough knowledge of the operation and applications of this important technique. Publication of the laboratory projects will extend the impact of these activities beyond the college.

Sonia L. Vazquez-Garcia  
University of Puerto Rico  
Humacao University College  
Humacao, RQ

CSI 8750795  
\$31,677

**"Upgrading of the Environmental Chemistry Laboratory through the Implementation of Water and Air Quality Surveillance Stations"**

Equipment needed to establish two continuous sampling and monitoring stations; one for air, the other for water surveillance, has been recently acquired by the Chemistry Department at Humacao University College. The availability of these two systems has significantly enhanced the Environmental Chemistry laboratory experiences of students enrolled in both the Associate Degree program in Chemical Technology and the Baccalaureate Degree in Industrial Chemistry curriculum. The air station continuously monitors basic air quality parameters such as carbon monoxide, sulfur dioxide, ozone, organics, heavy metals, and particulates. The water station continuously monitors basic water quality parameters such as temperature, pH, dissolved oxygen, organics, and heavy metals.

James G. Magyar  
Rhode Island College  
Providence, RI

CSI 8750620  
\$19,481

**"Improving Undergraduate Instruction with High Pressure Liquid Chromatography and Atomic Absorption"**

The Chemistry Department at Rhode Island College has recently acquired a high pressure liquid chromatograph (HPLC) and a computer interfaced atomic absorption (AA) spectrometer for use in improving undergraduate instruction. With these additions, students are exposed to a wider range of the instruments used in modern research and industrial laboratories and gain experience in using these instruments to increase their problem-solving skills. Analytical skills are being developed which will help prepare students for graduate school or careers in chemistry and other sciences.

Noel Kane-Maguire  
Furman University  
Greenville, SC

CSI 8750209  
\$50,000

**"Introduction of High-Field Nuclear Magnetic Resonance Spectroscopy into the Undergraduate Curriculum"**

A high-field nuclear magnetic resonance (NMR) spectrometer is a recent acquisition by the Chemistry Department of Furman University. This instrument, used for undergraduate instruction, provides experience with the most important advances in NMR of the past decade: methods for obtaining detailed structural information (high-field NMR); detailed procedures for elaborating that information (2-D NMR); and techniques for assessing the motion of molecules (relaxation measurements). Development of skills in these areas is extremely important in contemporary chemistry, and they provide the basis for NMR imaging, the technique expected to complement medical X-rays. This instrument is being used by students through the entire range of the curriculum from the instrumental analytical course through its use in undergraduate research.

Harvey F. Blanck  
Austin Peay State University  
Clarksville, TN

CSI 8750101  
\$18,608

**"Integration of a Fourier Transform Infrared Spectrometer into the Chemistry Curriculum"**

The Chemistry Department at Austin Peay State University has recently acquired a microprocessor-interfaced

Fourier Transform Infrared (FTIR) Spectrometer which is being used to enhance undergraduate instruction by integrating FTIR applications into several courses in the curriculum. Specifically, the system is used in instrumental methods of analysis and organic chemistry courses for compound identification and in physical chemistry to study the properties of compounds.

Nancy S. Mills  
Trinity University  
San Antonio, TX

CSI 8750180  
\$14,540

#### **"Optical Activity Determinations in Chemistry and Biochemistry"**

Spectropolarimetry is being fully integrated into the undergraduate chemistry curriculum at Trinity University. A polarimeter equipped with a monochromator and continuous sources affords applications that demonstrate the essential characteristics of optical activity measurements in understanding the 3-dimensional structure of chiral molecules. Determination of the optical rotations of inorganic complexes and organic compounds, the measurement of optical rotatory dispersion curves in conformational analyses and base stacking of nucleosides, and the determination of the specific rotation of pure enantiomers by modern methods are among the activities students are experiencing.

Herbert J. Sipe, Jr.  
Hampden-Sydney College  
Hampden Sydney, VA

CSI 8750395  
\$10,550

#### **"Atomic Absorption Spectrometry for a Project-Based Laboratory Program"**

Modern atomic absorption spectrometric (AAS) techniques are being incorporated into the project-based laboratory program in the Chemistry Department at Hampden-Sydney College, through the recent acquisition of a computer-controlled atomic absorption system. The addition of this instrumentation to current holdings, and its instructional use, further encourages attitudes of resourcefulness and independence in undergraduate students who can now profit fully from the spectrum of scientific instrumentation available. Realistic laboratory experiences are provided, beginning in the freshman and sophomore years and continuing with increasing sophistication to activities in the research-style junior/senior advanced laboratories.

Daniel M. Downey  
James Madison University  
Harrisonburg, VA

CSI 8750124  
\$19,992

#### **"Experimental Nuclear Chemistry in the Undergraduate Curriculum"**

Equipment needed to implement a course in nuclear chemistry has been recently acquired by the Chemistry Department at James Madison University. An alpha spectrometer, a gamma spectrometer, and an analyzer system were among the items included. The availability of this system provides chemistry majors (and minors), pre-medical, and pre-engineering students with training in modern nuclear measuring techniques involving pulse height measurements for alpha and gamma particle spectrometry. Along with teaching basic concepts, the use of nuclear counting equipment for neutron activation analysis, environmental monitoring, medical applications and selected applications of technical and social merit is included.

Michael A. Pleva  
Washington and Lee University  
Lexington, VA

CSI 8750106  
\$30,850

#### **"Nuclear Magnetic Resonance Spectroscopy"**

The recent acquisition of a nuclear magnetic resonance (NMR) spectrometer by the Chemistry Department at Washington and Lee University is affording students additional opportunities to become familiar with a broad spectrum of modern instrumental techniques. Specific applications of NMR spectroscopy have been incorporated into quantitative analysis, organic chemistry, organic qualitative analysis, instrumental analysis, and biochemistry. In addition, NMR is used extensively in the undergraduate research participation program, which has been a strong emphasis in the Department for many years.

Frederick D. Tabbutt  
Evergreen State College  
Olympia, WA

CSI 8750598  
\$39,887

#### **"Improving the Undergraduate Chemistry Curriculum with a Gas Chromatograph-Mass Spectrometer"**

A computer-based gas chromatograph with a mass selector detector (GC/MS) is being used by the Chemistry Department at Evergreen State College for undergraduate instruction in organic chemistry, physical chemistry, environmental chemistry and faculty/student research. By coupling this instrumental unit with an existing laboratory



computer network system, the advantages of computer interfaced analytical instrumentation in the sciences are also being demonstrated.

Kenneth Rousslang  
University of Puget Sound  
Tacoma, WA

CSI 8750047  
\$25,500

**"Integration of a Fourier Transform Infrared Spectrometer into the Chemistry Undergraduate Curriculum"**

A Fourier Transform Infrared Spectrometer is being used by the Chemistry Department at the University of Puget Sound to demonstrate state-of-the-art analytical techniques in six upper division courses: Physical Chemistry Laboratory, Spectroscopic Identification of Compounds, Inorganic Chemistry, Instrumental Analysis, Group Theory and Molecular Spectroscopy, and Forensic Chemistry. The inherent sensitivity, reliability, expanded wavelength capability and flexibility of this instrument affords students an expanded range of undergraduate educational experiences.

Philip K. Welty  
Anne B. Swanson  
Edgewood College

CSI 8750475  
\$8,985

**"Atomic Absorption Spectroscopy to Enhance the Undergraduate Laboratory Science Curriculum"**

The recent acquisition, at Edgewood College, of an atomic absorption spectrometer allows students to perform experiments and undertake projects involving trace metals in biological and environmental samples. In an integrated, interdisciplinary course for non-science and teacher education majors, students carry out projects involving the analysis of trace amounts of heavy metal pollutants (lead uptake in plants and mercury in human hair). In chemistry courses, students determine metal ions in biological fluids, and pursue student-originated projects to investigate mercury contamination of water supplies and fish in Wisconsin waterways. Non-science majors studying geoscience gain an appreciation for atomic absorption spectroscopy as a powerful tool in geochemistry and chemical oceanography by investigating trace inorganic nutrients in natural waters and determining the trace metal chemistry of rock and ore

samples. This project helps to meet a need for instrumentation-based laboratory experiences which excite the imagination of non-science majors and improve the science education of our future teachers. About 75% of the students directly impacted are women. Publication of experiments developed will extend the impact of the project.

David L. Klopotek  
St Norbert College  
De Pere, WI

CSI 8750790  
\$30,400

**"Nuclear Magnetic Resonance Spectroscopy in Undergraduate Chemistry Instruction"**

A nuclear magnetic resonance spectrometer has been acquired by the Chemistry Department of St. Norbert College for use in undergraduate instruction. The instrument is being used extensively in the following courses: organic, advanced organic, physical, instrumentation, biochemistry, and independent research. Experiments such as determining the pKa values of organic bases, measuring the percent enolization of acetylacetone, and the determination of coupling constants to distinguish between cis, trans, and geminal vinylic isomers are among the activities carried out. Students are provided with the hands-on experience expected by employers and graduate schools.

Timothy F. Crimmins  
University of Wisc.—Oshkosh  
Oshkosh, WI

CSI 8750071  
\$22,250

**"Fourier Transform Infrared Spectroscopy in the Undergraduate Chemistry Laboratory Curriculum"**

A Fourier Transform Infrared Spectrophotometer (FTIR) is being used by the Chemistry Department of the University of Wisconsin-Oshkosh to introduce chemistry students to the infrared techniques of data acquisition and manipulation, spectral storage, searching, and signal enhancement. This is being accomplished by introducing several new laboratory experiments, updating existing ones and offering expanded opportunities in undergraduate research. This curriculum development is having a direct impact on the physical chemistry, instrumental, inorganic, and spectroscopy laboratories and will significantly update the training of students in the area of Infrared Spectroscopy.

## COMPUTER SCIENCE

William A. Ward, Jr.  
University of South Alabama  
Mobile, AL

CSI 8750616  
\$50,000

### **"Unix Based Graphics Work Station Laboratory for Computer Science Students"**

A graphics workstation laboratory is being developed for use in a sequence of four junior and senior level computer science courses to demonstrate modern methods in software engineering and computer graphics. Students will acquire expertise in such methods by using state-of-the-art instrumentation to implement software projects which illustrate theoretical results in those fields. The project focuses on the use of graphics tools as visual aids for the design and analysis of software and on the use of those tools in the development of graphics software itself. The equipment includes a color monitor and four workstations for a student laboratory and a file server and one workstation for a faculty laboratory. The server, a high-speed microprocessor with a disk drive, provides disk space and additional computing power to the workstations. Eight existing PCs will be connected to the server; four will be placed in the student laboratory and four in faculty offices. Both laboratories will be housed in a newly remodeled facility. Project implementation spans a 2-year period with ample personnel available for equipment installation and course preparation.

Michael A. Erlinger  
Harvey Mudd College  
Claremont, CA

CSI 8750727  
\$50,000

### **"Parallel Processing System for Undergraduate Instruction"**

A parallel processing facility in support of courses in concurrent processing, is being set up. The core of the proposed system is a Sequent Balance 8000 computer with eight processors, eight megabytes of memory and an ethernet interface. The parallel processor will be used in several computer science courses and student design projects.

Roger E. Whitney  
San Diego State University  
San Diego, CA

CSI 8750569  
\$18,647

### **"Computer Aided Learning Lab for Undergraduate Computer Science"**

An Appletalk Local Area Network will be set up linking 16 Macintosh computers, a hard disk, and two Imagewri-

ters. The resulting laboratory will be used for the undergraduate teaching of programming algorithms. Besides graphics, dynamic animation of data structures and algorithms, the timing and measurement of algorithms, and the associated data analysis and graphing will be used in the laboratory.

Richard H. Gordon  
Sonoma State University  
Rohnert Park, CA

CSI 8750557  
\$17,973

### **"Development of a Modern Undergraduate Computer Graphics Laboratory"**

An undergraduate computer graphics laboratory using a DEC Microvax II will be acquired. Using interfaces, the computer will serve as a dedicated machine with four existing graphics terminals. Two undergraduate courses will be supported by the laboratory, and seniors will use the laboratory for special projects such as processing astronomical images and producing geological maps.

Ataollah Elahi  
Southern Conn. State College  
New Haven, CT

CSI 8750749  
\$31,300

### **"An Undergraduate Computer Hardware Laboratory"**

A computer hardware development laboratory will be developed to include fifteen student stations, each equipped with an Intel SDK-86 microcomputer board, an oscilloscope, digital voltmeter, signal generator and design trainer. The laboratory will support three new lower level courses: Computer Organization and Logic, Microcomputers, and Microprocessor Interfacing.

Porter D. Sherman  
University of Bridgeport  
Bridgeport, CT

CSI 8750129  
\$50,000

### **"An Undergraduate Interdisciplinary Artificial Intelligence Laboratory"**

An artificial intelligence laboratory is being developed to be shared by both the department of science and en-

gineering and the department of psychology. The laboratory will be equipped with eight "pseudo" Lisp machines which will also have the capability to handle Prolog and Smalltalk. Four new courses are proposed which will be jointly developed by the two departments. Thus, the new lab will serve both the computer engineering and the cognitive psychology students.

Timothy C. Diller  
Taylor University  
Upland, IN

CSI 8750513  
\$30,476

#### **"An Undergraduate Artificial Intelligence Teaching Laboratory"**

The artificial intelligence (AI) program at Taylor University is being enhanced in two ways. It is providing sufficient IBM PC/AT computing resources to support the teaching of Lisp, processing text, developing image processing programs and the teaching of expert systems. It is also making possible, through the acquisition of a TI Business Pro computer, student learning of speech processing. The package is allowing instruction, demonstration, research and experimentation in four AI courses, involving natural languages, image processing and expert systems. Students are developing and executing algorithms which understand speech, identify speakers and languages, and enhance the intelligibility of speech, as well as those which compress and generate speech.

David Lawson  
Stetson University  
Deland, FL

CSI 8750568  
\$21,255

#### **"The Upgrade of a DEC Microvax II to an Undergraduate Laboratory Teaching Tool"**

The principal investigator is upgrading an existing DEC Microvax II to provide an undergraduate teaching laboratory. With the addition of a 159 megabyte disc, port selector, and upgrades to existing Rainbow terminals, sixteen students will be accommodated. Three upper division courses, Operating Systems; Assemblers, Compilers and Translators; and Computer Graphics will be served by the upgraded laboratory. In addition to the formal courses, the laboratory will provide a base for experimentation by an undergraduate student research group doing research on modeling and cognitive science. Among the experiments planned for research are neural network simulation, pattern recognition of video frames, and Sejnowski's Nettek experiment. The intent will be to create hypothetical neural structures and then examine their performance.

Theodore F. Elbert  
University of West Florida  
Pensacola, FL

CSI 8750068  
\$47,179

#### **"The Establishment of an Undergraduate, Real-time, Embedded System Software and Interfacing Laboratory"**

An integrated laboratory to support instruction in three areas is being established. They are: (1) Development of software that must function in a real-time, embedded system environment; (2) The interfacing of embedded computers to their external environment; and (3) The relationship between embedded systems and the external environment.

The laboratory will consist of six Motorola VME-10 microcomputers that can be interconnected and/or networked through individual serial or parallel devices or through an IEEE-488 bus. The VME-10 computers will be used both singly and in combination to control plants simulated by COMDYNA analog computers.

Hari B. Bidasaria  
Central Michigan University  
Mount Pleasant, MI

CSI 8750078  
\$37,330

#### **"An Undergraduate Laboratory in High Resolution Graphics and Image Processing"**

A high resolution computer graphics and image processing microcomputer laboratory is being set up. Using IBM PC/AT's as workstations connected by a local area network to a Cyber 170 computer, students will be able to apply various techniques of solid modeling, shading, animation and surface texturing. A slow-motion video tape recorder will be used to record images a frame at a time, which, when played back at normal speed will give the sensation of motion.

James A. Leone  
Canisius College  
Buffalo, NY

CSI 8750291  
\$37,890

#### **"An Undergraduate Imaging and Operating Systems Laboratory Enhancement"**

Four Sun 3/110C microcomputers are being added to the imaging and operating systems laboratory. The courses associated with the laboratory will be radically changed to allow the teaching and experimentation in advanced graphics. Student research in the area of Lyndenmayer Systems will be conducted. In the area of operating systems, experiments in process scheduling, device handling, multiple



asynchronous processes and paged virtual memory systems are planned.

Edward M. Crosson  
Siena College  
Loudonville, NY

CSI 8750275  
\$49,404

#### **"Computer Graphics Equipment to Enhance Undergraduate Curriculum"**

A computer graphics laboratory using the Tektronix color graphics workstations with additional computer display terminals is being set up. This updated laboratory will be able to support instruction in animation, use of color, three dimensional graphics and the use of graphics standards. The proposed equipment will allow enhancement of the curriculum through addition of new topics to the introductory course and the enhancement of student research in graphics through independent study projects.

Evelyn P. Rozanski  
Rochester Institute of Technology  
Rochester, NY

CSI 8750705  
\$50,000

#### **"A Workstation Environment for an Undergraduate Computer Graphics Sequence"**

A graphics laboratory of six Sun 3/110 workstations networked to support a sequence of undergraduate graphics courses is being installed. Included will be a new course to cover aspects of graphics such as three dimensional modeling, shading, animation, ray tracing, antialiasing, fractals, and manipulation of color look-up tables. The project will provide returning cooperative education students the opportunity to test skills and knowledge obtained through practical experience in the structured environment of a university laboratory.

Christopher H. Nevison  
Colgate University  
Hamilton, NY

CSI 8750392  
\$35,892

#### **"An Undergraduate Parallel Processing Computer Laboratory"**

An undergraduate computer laboratory in parallel processing is being equipped with an INMOS, forty processor, parallel machine which can be flexibly configured in either ring, mesh, shuffle-exchange, or hypercube architectures. IBM PC/AT compatible machines will be used for both the front-end and as a development system.

Integrated with the laboratory will be a course on parallel processing covering the topics of architecture, algorithms,

and programming languages. Topics on parallel processing will be integrated into the courses Analysis of Algorithms, Programming Languages, VLSI Design, Graphics, and Simulation.

Wayne Lang  
Univ of North Carolina Asheville  
Asheville, NC

CSI 8750237  
\$12,732

#### **"An Undergraduate VLSI Design Workstation Laboratory"**

This project will make innovative use of the microwave network being installed by the State of North Carolina to link the Asheville campus to the North Carolina Microelectronics Center. Using IBM PC AT's as workstations, students will be able to use the computing power of the Center remotely. Thus, at modest cost, fairly sophisticated design can be done at the undergraduate level in this emerging field.

Larrie V. Hutton  
Marietta College  
Marietta, OH

CSI 8750596  
\$22,005

#### **"Providing Expert System Development Tools to Undergraduate Students"**

Expert system development tools are being provided to students in an undergraduate course in artificial intelligence (AI) at Marietta College. These tools will provide students with the means to develop programs that are able to apply the rules used by human experts when they solve problems. The Compaq 80386 computers and the OPS5 + expert development system used in this grant will give students practical experience in the design and implementation of an expert system. The project chosen for this class is the development of a system that may help mental health practitioners to differentiate between clients with schizophrenia, which is a serious (psychotic) mental disturbance, and various forms of personality disorders, which are less serious. This distinction is often a difficult one for psychologists and psychiatrists to make accurately. Students will be able to evaluate the validity of their system by comparing the diagnoses produced by the expert system to those of professionals in the field.

Dale L. Wampler  
Juniata College  
Huntingdon, PA

CSI 8750290  
\$37,930

#### **"Unix C and Graphics Upgrade of the Undergraduate Computer Science Program"**

Six upper level courses of the computer science program. The improvement will be made possible by the pur-

chase of four workstations and one file server that are Unix based and feature high resolution graphics displays. The availability of Unix and C will allow students to attack more significant software projects in Operating Systems, Programming Languages and Compiler Construction. Students in Computer Graphics will be able to perform more sophisticated graphics modeling and access standard graphics libraries in their software projects. Students in the Computer Science Senior Research Courses will be able to perform experiments on system parameters and performance because a given student will be able to have exclusive control at a workstation for blocks of time. Experience with Unix is becoming crucial because of its dominance as an operating system used in graduate programs. Furthermore, experience with Unix, C, high performance graphics workstations and networked systems is very advantageous to graduates entering professional computer science careers today.

John A. Beidler  
University of Scranton  
Scranton, PA

CSI 8750630  
\$48,660

#### **"An Undergraduate Software Engineering Laboratory"**

Under this effort, the principal investigator will construct an undergraduate software engineering laboratory of six Sun 3/52 computer workstations. This laboratory will create an environment in which the students can be taught the software system's specification, design, implementation, and maintenance. The work station will have substantial local computation power, primary and secondary storage and communication support to other devices, including the university's functioning system. Ethernet will be used to link the laboratory to the main university computer as well as other University Networks.

Carol M. Smith  
University of Puget Sound  
Tacoma, WA

CSI 8750013  
\$31,405

#### **"Development of an Undergraduate Computer Graphics Laboratory"**

A computer graphics laboratory using Tektronix computer graphics terminals is being developed. The laboratory will support a new computer graphics course and an ongoing program of student research. The new course will emphasize the applications of mathematics to computer graphics and will enable students to study and experiment with the algorithms and mathematical techniques of two and three dimensional graphics.

David D. Riley  
University of Wisconsin La Crosse  
La Crosse, WI

CSI 8750820  
\$50,000

#### **"An Undergraduate Computer Aided Software Engineering Laboratory"**

A computer aided software engineering (CASE) environment for first course students in computer science is being established. As CASE is already used in the industrial environment, this project will be unique in bringing it into the undergraduate environment. The CASE environment places increased importance on modularization, abstraction, team programming skills and the use of automated aids to software development. Ten Apollo workstations with associated mass storage elements will make up the environment. An important component of this project is the development of software modules and curricular materials for the integration of CASE equipment into the undergraduate environment.

## **EARTH SCIENCE**

Roswitha B. Grannell  
California State Univ Long Beach  
Long Beach, CA

CSI 8750776  
\$38,704

#### **"Implementation of Field-Oriented Projects into the Senior Level Undergraduate Geophysics Curriculum"**

California State University, Long Beach, will purchase a seismograph with tape drive and falling-weight source, and supporting computing facilities to allow completion of two field projects (one each semester) in the senior level geo-

physics sequence. In the introductory geophysics (first semester), the equipment will be combined with departmental holdings in gravimetry, magnetics and electrical resistivity to conduct an engineering geophysics project, to help identify recently active traces of the San Andreas fault near Mecca Hills, California. In petroleum geophysics (second semester), the laboratory will use seismic reflection studies, combined with gravity and magnetic work, to characterize the subsurface geology in a producing oil field near Coalinga, California. In both cases, students will help plan the project from available literature, collect, reduce, and interpret data, and do some geological field work to facil-

itate interpretation. Specific reduction techniques have been chosen to supplement lecture and laboratory sessions. A final comprehensive report will be written by each student for each project.

Thomas P. Huber  
Univ of Colorado at CO Springs  
Colorado Springs, CO

CSI 8750041  
\$49,474

#### **"Image Processing/Analysis System and Remote Sensing Center for Undergraduate Students"**

The University of Colorado, Colorado Springs, will obtain current production quality image analysis equipment to be used in the undergraduate curriculum for geography and environmental studies majors, geology/geography distributed study majors, and students in other related disciplines. The present curriculum will be redesigned to contain an introduction to image processing at the level of Introduction to Remote Sensing. Traditional air photo interpretation and photogrammetry will still be introduced in this course. The proposed new equipment will be used for the entire Advanced Remote Sensing course. Students will get in-depth instruction and extensive hands-on experience with the new system. The class will be designed so that at the end of the course students on their own will be able to function well with all of the system capabilities to solve real remote sensing and image analysis problems. A new seminar, Practicum in Image Processing, will be added to the curriculum. This course will be the organizational mechanism for establishing the Southern Colorado Remote Sensing Center in which students will elicit real world remote sensing problems from local and regional government agencies (e.g. planning departments), private enterprise firms on a cost paid basis, and university projects. The students will then design, produce, and present their work to the data requester.

Scott F. Argast  
Purdue University Fort Wayne  
Fort Wayne, IN

CSI 8750250  
\$45,175

#### **"Acquisition of an X-ray Diffractometer for the Undergraduate Geology Curriculum"**

The University will introduce x-ray diffraction techniques into the undergraduate geology curriculum. X-ray diffraction is an essential tool for understanding crystal structures and mineralogy. The equipment consists of a Phillips X-ray diffraction system with scintillation detector and powder camera, sample preparation equipment, and microprocessor control. The equipment will find use in introductory mineralogy and petrology courses, advanced

optical mineralogy and petrography courses, a techniques oriented course in x-ray mineralogy and as part of independent undergraduate research. With the availability of an x-ray diffractometer, students will gain a greater appreciation of the fundamental principles of crystallography and mineralogy and be better able to function as working geologists following graduation.

Mary Savina  
Shelby J. Boardman  
Carleton College  
Northfield, MN

CSI 8750682  
\$45,500

#### **"Purchase of an X-Ray Diffraction Unit for Undergraduate Geology"**

The Carleton College Geology Department will purchase a semi-automated x-ray diffraction unit. The diffractometer is needed by the Geology Department to teach modern x-ray techniques in mineralogy, soils, and advanced petrology courses. These classes will teach x-ray theory and practice in lectures and laboratory exercises. Virtually all geology majors take at least one of these classes. The diffractometer is also needed for student research projects, including senior integrative exercises required of each major.

Alan H. Strahler  
CUNY Hunter College  
New York, NY

CSI 8750866  
\$50,000

#### **"Undergraduate Laboratory for Remote Sensing, Digital Image Processing, Automated Cartography and Geographic Information Systems"**

This project involves the establishment of a laboratory at Hunter College, part of the City University of New York, within the department of Geology and Geography. The project will integrate an existing program in remote sensing and image processing with related new and existing classes in geographic information systems and analytical cartography. This goal will be achieved by the establishment of a new laboratory containing four IBM-PC AT-based Earth Resources Data Analysis Systems, with associated geographic data processing modules, and the PMAP geographic information system software. When integrated with existing and new department computer hardware and software, this facility will offer a state-of-the-art instructional environment for the laboratory component of three separate but related areas of undergraduate course work. These courses will strengthen an existing undergraduate program in remote sensing by providing a common ground between remote sensing and image processing, analytical and computer cartography, and geographic information systems. The



resulting specialization will provide students with advanced undergraduate training for geographic information processing, and will give them experience with a system which is becoming something of an industry standard.

Diane R. Smith  
Trinity University  
San Antonio, TX

CSI 8750215  
\$38,650

**"Energy-Dispersive X-ray Fluorescence Spectrometry: Undergraduate Applications in Geology and Geochemistry"**

A "hands-on" understanding of the techniques and applications of whole-rock geochemical analysis is an essential part of a student's undergraduate preparation in Geology. The Department of Geology at Trinity University will integrate an energy-dispersive x-ray fluorescence spectrometer system (ED-XRF) into its undergraduate curriculum. All students whose eventual careers might require the application of geochemical principles will be exposed to the multiple uses of this technique. The instrument will be used as a tool in courses and research, with an emphasis on its use in solving geologic problems including the origin of igneous, metamorphic, and sedimentary rocks and ore deposits. Development of the program will be achieved through the acquisition of an ED-XRF which has capability to produce quantitative, multi-element analyses of silicate rocks.

Bernd H. Kuennecke  
Radford University  
Radford, VA

CSI 8750086  
\$50,000

**"Automated Land Resources Inventory and Analysis System"**

Radford University will purchase an automated land resources inventory and analysis system and field surveying equipment. The data acquisition, data analysis, and geographic information systems with their peripheral hardware and software components will be used by undergraduate students at Radford University as part of their educational program. These inventory and analysis systems are used by scientists in many fields (geography, remote sensing, urban and regional planning, environmental protection, civil engineering, transportation planning, etc.) and are now being employed by private firms, governmental agencies, academic research institutions, and educational institutions.

William C. Smith  
Central Washington University  
Ellensburg, WA

CSI 8750132  
\$50,000

**"Undergraduate Instruction in Geographic Information Systems"**

The Geographic Information Systems Laboratory at Central Washington University provides computer hardware and software support for geographic information systems applications, allowing users to store, retrieve, display, manipulate and analyze maps and other spatial data. A state-of-the-art tool for data processing in the earth sciences and in resources management fields, the GIS Lab heretofore has been used primarily as a research facility; equipment needed for purposes of undergraduate instruction has been lacking. The University is buying a Masscomp computer system, 3 color and 6 monochrome terminals, software, and communications hardware. By providing necessary equipment, the project will enable the University to realize the GIS Lab's great potential as an undergraduate teaching facility, and thereby respond to growing student interest reflecting the rapid expansion of GIS application in academic research, government, and industry.

J. Stewart Lowther  
University of Puget Sound  
Tacoma, WA

CSI 8750167  
\$34,682

**"An X-ray Microanalysis System for Undergraduate Geology"**

The Department of Geology at the University of Puget Sound will purchase an energy-dispersive quantitative X-ray microanalysis system with image processing capabilities to be mounted on an existing scanning electron microscope.

This instrumentation will be integrated into the undergraduate geology curriculum at all levels above the introductory courses and will be used for student and student-faculty research projects. The equipment will allow students to analyze the chemical composition of very small regions of rock and mineral samples and thus assist in the identification and characterization of the samples. A modern laboratory facility now houses the University's electron microscope and will house the new system.

## ENGINEERING

Russell M. Hayes, Jr.  
University of South Alabama  
Mobile, AL

CSI 8750613  
\$16,317

### **"Introduction of an Advanced Undergraduate Software Development Station"**

This project is to enhance the senior engineering design project laboratory with a software development station. It is an extension of the existing undergraduate laboratory instruction which is based on the Motorola Educational Computer Board and using the MC68000 assembly language. The station reflects the latest in microprocessor emulation, and will be based on the IBM PC/AT with a 68000 co-processor module. Using emulators for the 68000, 6809, and 68HC11, a variety of design projects can be supported in the area of digital signal processing and control.

Nasser Rashidnia  
Arkansas Tech University  
Russellville, AR

CSI 8750103  
\$30,656

### **"An Undergraduate Thermofluids Measurement and Analysis Laboratory"**

Modern measurement and analysis equipment will be used to upgrade an existing thermofluids laboratory under this project. The three areas to be covered include fluid flow anemometry, pressure measurement, and temperature measurement. In each of these areas, modern sensors will be obtained and interfaced with microcomputers. These include hot wire and film anemometers, pressure transducers, total, static and boundary layer pressure probe sensors, and temperature transducers. With this equipment, a variety of experiments will be performed including fluid flow velocity, dynamic and static pressure, aerodynamic drag, and heat and mass transfer with temperature distributions in flow fields.

Hirak C. Patangia  
University of Arkansas Little Rock  
Little Rock, AR

CSI 8750732  
\$50,000

### **"A Modern Undergraduate Engineering Technology Measurement Laboratory"**

A novel undergraduate engineering technology measurements laboratory is planned. Recognizing that self-contained instruments such as oscilloscopes and signal generators

are covered early in the curriculum, it will emphasize computer controlled test instrumentation, especially in-circuit testing using bed of nails instrumentation. Other areas that will be covered include the measurement of voltage, current and power with complex wave forms such as periodically switched voltages. This will be accomplished using digitized oscilloscopes and computer analysis. Another area which will be covered is device modeling through impedance analyzer measurements.

Young C. Kim  
California State Univ L.A.  
Los Angeles, CA

CSI 8750146  
\$12,880

### **"An Undergraduate Coastal Hydraulics Laboratory Wave Generating Channel"**

This project is to construct a wave generating channel for the undergraduate fluids laboratory in coastal hydraulics. It will provide the students equipment to study wave mechanics, kinematics, and wave transformation. The channel will be used in courses covering coastal hydraulics and coastal engineering.

David Wright  
San Diego State University  
San Diego, CA

CSI 8750415  
\$50,000

### **"Digital Techniques in an Undergraduate Electrical Engineering Laboratory"**

Demonstration of the use of digital techniques in representative electrical engineering contexts is the object of the proposed laboratory. The associated course is aimed at EE seniors and is comprised of a set of experiments which broadly exhibit the use of digital processing within EE systems. Eight similarly equipped student stations plus a central station for one-of-a-kind equipment form the ensemble purchased under this grant. Each station includes a unit for capturing, processing, and creating electrical wave forms. These units are basically general purpose micro-computers augmented with data acquisition and control modules. Additional instrumentation to create and observe signals, to produce output action, and to record results is proposed also and includes signal generators, transducers, oscilloscopes and other items of general purpose test equipment. The laboratory course is new and self-contained and complements several undergraduate EE courses for which no supporting laboratory activity currently exists. Many experiments involve the physical senses. Together they dem-

onstrate: the basic effects of quantization in time and in amplitude; serve action with an imbedded digital processor; random process phenomena; digital filtering; and signals encountered in telephony robot biomedical instrumentation, et cetera.

James G. Harris  
California Polytechnic State Univ.  
San Luis Obispo, CA

SI 8751395  
\$52,206

#### **"Workshop on Undergraduate Education in Electrical Engineering"**

In response to the National Science Board report and subsequent workshop, a workshop on undergraduate electrical engineering education was conducted in May 1987 in Kansas City. The discipline of electrical engineering is the largest engineering discipline in the United States. It is also the principal driving force behind many of the technological changes that are impacting science and engineering education. Thus, special attention is being given to electrical education curricula because of the discipline's impact on society through the human resources and technology produced. The purpose of the workshop was to identify the types of undergraduate curricula-related initiatives needed for electrical engineering and the best investigative models for addressing these initiatives. The workshop report was distributed to the 230 U.S. electrical engineering department heads and the results were disseminated at both the annual meeting of the American Society of Engineering Educators and the Frontiers in Education conferences.

Unny Menon  
California Polytechnic State Univ.  
San Luis Obispo, CA

CSI 8750022  
\$32,080

#### **"An Undergraduate, Robotics Application, Instructional Work cell"**

A Technovate robotics instructional work cell will be installed in the multi-disciplinary center for computer-integrated manufacturing. It will enhance and broaden the scope of undergraduate instruction in robotics and enable new experiments in system integration and campus network interfacing. The work cell is particularly adaptable to electronics manufacturing applications and has the capability for off-line programming. The work cell includes an IBM 7535 industrial robot with Z-80 microprocessor, an IBM PC with AML/E robotics software for off line programming, and safety interlocks. The open systems architecture will allow experimentation linking the cell with an existing ZILOG development system.

Satwant S. Rihal  
California Polytechnic State Univ.  
San Luis Obispo, CA

CSI 8750748  
\$23,250

#### **"Upgrading of Undergraduate Structural (Seismic) Testing Laboratories"**

The undergraduate seismic laboratories will be improved with the addition of two model shaker stations. This will give architectural engineering students first hand experience in the use of modern seismic testing equipment to verify the fundamental concepts of structural behavior. The two shaker stations will be equipped with Acoustic Power Systems Electro-seis horizontal shakers, VIPAC vibration testing work stations for test control, data acquisition and processing and a Hewlett Packard spectrum analyzer and plotter. The stations will allow senior architectural engineering students to experimentally investigate not only fundamental dynamic properties and response of small-scale building structures but also the relationship between structural stiffness and corresponding natural frequencies.

Daniel W. Walsh  
California Polytechnic State Univ.  
San Luis Obispo, CA

CSI 8750170  
\$50,000

#### **"An Undergraduate Thermomechanical Test Laboratory"**

Under this project, a Gleeble test facility will be constructed for undergraduate materials laboratory experiments. The facility will allow students to conduct experiments involving the dynamic thermal and mechanical stressing of materials, simulating the process stresses received during manufacture and use. In addition, basic property determinations will be made, including dilatometry deformation mapping, weld heat affected zone studies, sintering, solidification, heat treatment, precipitation kinetics, hot ductility, corrosion, and thermal fatigue and stress rupture. It is expected that this facility will provide a prototype undergraduate metallurgy and materials laboratory for the 1990's.

Ralph Gagnon  
California State University Chico  
Chico, CA

CSI 8750147  
\$29,950

#### **"An Undergraduate Optical Electromagnetic Wave Laboratory"**

A laboratory to demonstrate electromagnetic wave principles in the optical region is being developed primarily for a second course in Electromagnetics and a new course



in Fourier Optics. The electromagnetics course focuses on wave phenomena, and optical wavelengths are giving the students practical experience and applications. In addition to a light valve projector, the appropriate optical bread-board equipment, including lasers, tables, illumination systems and positions are being purchased. Using the system, the principles of birefringence, polarization, illumination, interferometry, optical Fourier transforms, light valves, and conventional optics are being demonstrated.

Franklin E. Fisher  
Loyola Marymount University  
Los Angeles, CA

CSI 8750454  
\$43,000

#### **"An Undergraduate Materials Science/Metallurgy Laboratory"**

The undergraduate materials science and metallurgy laboratory will be upgraded with modern equipment. In addition, the emphasis in the laboratory will be changed from qualitative to quantitative measurements. Improved will be the present experiments in deformation hardening, alloying effects, heat treatment, recrystallization, precipitation hardening, and martensitic strengthening. With the new equipment, five new experiments will be added covering time, temperature, transformation curves, stress-strain characteristics, solid solution hardening, multiphase eutectic structures and general metallography. These new experiments will use instruments such as nanovoltmeters and electrometers, micro- and regular hardness testers, and optical microscopes.

David G. Pelka  
Northrop University  
Los Angeles, CA

CSI 8750242  
\$50,000

#### **"Creating an Undergraduate Electro-optics Laboratory at Northrop University"**

This project is to set up a new electro-optics laboratory, a field that is emerging as one of the critical areas of telecommunications. Instrumentation such as monochrometers, low power lasers, pyroelectric radiometers and fiber optics communications links will be integrated into an undergraduate laboratory. New experiments are to be developed which will strengthen undergraduate education in the fields of lasers, fiber optics communications, electro-optical instruments and holography.

Roy B. Davis, III  
Trinity College  
Hartford, CT

CSI 8750859  
\$11,602

#### **"Automating the Undergraduate Engineering Materials Laboratory"**

Under this project, the materials science and engineering strength of materials laboratory will be automated. A bench-

top Instron Model 1011, 1000 pound load capacity will be added to the laboratory to supplement an existing 20,000 pound load capacity machine. The new instrument is equipped with an IEEE 488 bus that will be interfaced with a Macintosh Plus computer equipped with a National Instruments interface board and labVIEW software. The students will be able to learn real time control and computer data acquisition and analysis. The experiments planned include the testing of both metals and polymers. In addition, the data acquisition system will be used to measure the electrical properties of materials, including semiconductors.

Gerald T. Volpe  
University of Bridgeport  
Bridgeport, CT

CSI 8750110  
\$49,650

#### **"An Undergraduate Communication Systems Laboratory"**

This project will support five communications courses with an updated communications laboratory. The intent is to give the students hands-on experience with actual equipment so that they can solidify their theoretical knowledge by means of experimental observations. Analog and digital signalling techniques will be covered, including baseband, FSK, PSK, and PCM, matched filtering, and linear and angle analog modulation. In addition, special topics will be covered in the areas of phase lock loops and antenna gain, radiation pattern and impedance matching.

Michael E. McKaughan  
United States Coast Guard Academy  
New London, CT

CSI 8750498  
\$11,000

#### **"An Undergraduate Computer Assisted Scalar Network Analysis Laboratory"**

The equipment necessary to assemble a scalar network analysis system for use in an undergraduate antenna design laboratory is being procured. Using a Hewlett Packard 8756A network analyzer as a basis, a system is being constructed to allow students to investigate the transfer characteristics of transmission lines, impedance transformation devices and the design of antennas. Computer programs are being developed to implement the experiments and to perform mathematical computation on the collected data.

H. David Snyder  
Gallaudet University  
Washington, DC

CSI 8750356  
\$36,869

#### **"Undergraduate Engineering Technology Program for the Hearing Impaired"**

The Physics Department of Gallaudet University will establish programs in Computer Engineering technology and

exit at three levels of proficiency: A.A. (Engineering Technician), B.S. (Engineering Technologist) and Certificate (suitable for change of career re-training). Instruction will be laboratory oriented emphasizing hands-on-experiments for all topics. All faculty serving the program will be proficient in the Simultaneous Method of Communication for hearing impaired persons. This method of communication employs the simultaneous use of sign language, finger-spelling and speech permitting each student to employ the method in which he or she is most proficient. Thus, this program in addition to being a model for the training of the hearing impaired will also serve as a model for programs in which it is desired to give hearing and hearing impaired students full and equal access to classroom instruction and faculty assistance.

F. Jalali  
Fort Valley State College  
Fort Valley, GA

CSI 8750539  
\$18,570

#### **"Data Acquisition Workstations for the Undergraduate Linear Circuit Laboratory"**

This project will equip an advanced electronic laboratory with six experiment stations. Each station will contain an IBM PC/XT, a Keithley Data Acquisition System and a Digital Multimeter with analog outputs. The stations will allow very rapid data collection, leading to an increase in the number of experiments that the students will be able to perform. Rapid data collection will also allow the students to examine the circuit characteristics as the parameters are changed resulting in a fuller understanding of the design of circuits.

Richard L. Gonzales  
Purdue University Calumet Campus  
Hammond, IN

CSI 8750330  
\$47,970

#### **"A Microcomputer Applications Course and Laboratory for All Undergraduate Engineers"**

This project will develop a sophomore course and associated laboratory required for all engineering students at Purdue-Calumet. It will teach them the fundamentals of embedded microcontrollers using the Embedded Systems Minion Teach module. The goal of the course and the significant laboratory component is to bring to students, who have an introductory knowledge of electric circuits and high-level language programming, a broad knowledge of the design of turn-key, embedded microcomputer controllers.

Ronald S. Artigue  
Rose-Hulman Institute of Tech  
Terre Haute, IN

CSI 8750150  
\$9,687

#### **"Introduction of Biotechnology into the Undergraduate Chemical Engineering Curriculum"**

This project will assist the institution in introducing biotechnology into the chemical engineering curriculum. A bench-scale fermentor and ancillary equipment will be coupled to a microcomputer-controlled data acquisition system. This will result in a system that permits students to learn about the special conditions and problems associated with fermentation, an industrially important biotechnology process. The computer controlled data acquisition system will provide flexibility in experimentation, enhance data reduction and analysis, and expose the students to modern instrumentation.

Leland K. Shirely  
Rose-Hulman Institute of Tech  
Terre Haute, IN

CSI 8750480  
\$50,000

#### **"New Instrumentation and Equipment to Extend Instructional Capabilities in Undergraduate Mechanical Engineering at Rose-Hulman"**

The project has two major goals, to make experimentation an integral part of a large set of courses in the Mechanical Engineering curriculum which have traditionally relied on the strictly lecture/recitation type of presentation; and to provide students with an exposure to complicated instrumentation systems which contain essential features of systems currently used in non-academic environments.

The project relies heavily on three general purpose data acquisition modules and one special purpose signal processor-an FFT analyzer. Two complex Mechanical Engineering systems, a laboratory model of a steam turbine and a full scale numerically controlled milling machine, will support the goals of the project. Finally a set of state-of-the-art flowmeters will extend the Department's inventory of scientific instrumentation.

Gerald R. Seeley  
Valparaiso University  
Valparaiso, IN

CSI 8750643  
\$27,100

#### **"A Universal Testing Machine for an Undergraduate Civil Engineering and Materials Engineering Laboratory"**

A modern, computer-controlled universal testing machine is being introduced into the undergraduate civil en-

engineering and materials engineering laboratory. By using the computer-controlled machine, the student is able to run many similar experiments, thus demonstrating the randomness of data and the requirement for statistical analysis. Computer analysis is also allowing the student to observe and produce many different types of data. All of the activities are being done during the laboratory period and thus more tests can be conducted if necessary.

|                                   |             |
|-----------------------------------|-------------|
| Ibibia K. Dabipi                  | CSI 8750565 |
| Southern University A & M College | \$49,956    |
| Baton Rouge, LA                   |             |

#### **"An Undergraduate Digital Communications Laboratory Project"**

Under this project, four Lab-Volt Model 8085 Digital Communications Training Systems will be used to upgrade the communication systems laboratory. Using this equipment, the students will be able to perform experiments in the areas of sampling, analog to digital conversion, spectral analysis of digital modulation schemes, signal to noise ratio, and bit error analysis of digital transmission systems and error correction code implementation. These experiments will enhance the learning of students in the digital communications area.

|                         |             |
|-------------------------|-------------|
| Peter H. Anderson       | CSI 8750327 |
| Morgan State University | \$50,000    |
| Baltimore, MD           |             |

#### **"Enhancement of an Undergraduate, General Purpose Interface Bus (GPIB) Controlled Electrical Engineering Laboratory"**

The School of Engineering at Morgan State University will enhance its undergraduate, lower-level, electrical engineering laboratories by the addition of GPIB instrumentation. This will enable the student to either manually control an experiment or to develop a computer program to control the instrumentation and take measurements with a computer. The computer control will also allow the student to reconfigure the circuit under test rapidly, analyze the data with the full power of the computer, and finally, display the data on a digital oscilloscope.

|                           |             |
|---------------------------|-------------|
| Harry Harrison            | CSI 8750313 |
| Capitol Institute of Tech | \$37,991    |
| Laurel, MD                |             |

#### **"An Undergraduate Network and Distributed Processing Laboratory"**

Students majoring in electronics, computer and telecommunications engineering technology will be provided with

expertise in the concepts of local area networks and distributed processing. In addition, courses in computer graphics and computer-aided design will be significantly broadened and enhanced. The need to become proficient in these areas is acute, particularly as the technology continues to move from large mainframes to the use of PCs. The project involves purchasing 16 Tandy 3000 HD PCs with the XENIX operating system, 16 ViaNet systems, two printers and an AutoCAD software package. They will be connected into a local area network and tied to a VAX 11/750 which will be used as the file server. Special projects will be arranged for students interested in additional knowledge in local area networks.

|                                      |             |
|--------------------------------------|-------------|
| Emin Yilmaz                          | CSI 8750325 |
| University of Maryland Eastern Shore | \$16,425    |
| Princess Anne, MD                    |             |

#### **"Upgrading of an Undergraduate Materials Testing Laboratory"**

The objective of this project is to improve the materials testing laboratory for the Engineering Technology and Construction Management and Technology programs at a primarily minority institution. A new strength of materials course will be developed to support the general engineering program. An IBM PC/XT will be interfaced to a tensile tester to provide experience in automated data acquisition. In addition, an impact tester, polariscope, polisher/grinders, and a materials microscope will be obtained.

|                                 |               |
|---------------------------------|---------------|
| Jack L. Kerrebrock              | CSI 8751507   |
| Massachusetts Institute of Tech | \$35,000      |
| Cambridge, MA                   | FY88 \$98,948 |

#### **"Workshop on Engineering Education"**

The Forum on Engineering Education (1987) is being convened by a Consortium of MIT, Stanford and the University of California at Berkeley with the support of the National Science Foundation. It is the first step toward the organization of a consortium of research universities and primarily undergraduate institutions to address the crucial problems of engineering education in the United States. The Forum will proceed from the premise that better collaboration of these types of institutions can help mitigate the problems such as faculty shortages and the technical obsolescence of faculty and practicing engineers which presently face engineering education in the United States. A three day workshop is planned with participation by two persons from each of several institutions in addition to those representing the members of the consortium.



Mohammad Khosrowjerdi  
Western New England College  
Springfield, MA

CSI 8750738  
\$40,464

**"Computer-Aided Design Hardware and Software for Integration of CAD into the Undergraduate Mechanical Engineering Curriculum"**

Under this project, computer aided design will be integrated into the mechanical engineering curriculum. The laboratory will be built around the Tektronix 4125 and 4129 color graphics workstations with graphics terminals. These in turn will be networked on a Data General MV 4000. Among the improvements planned are: the incorporation of solid modeling techniques into the freshman engineering graphics, kinematic movements of linkages, thermal analysis using ANSYS, the analysis of beams using an in-house developed package, and the use of ANSYS as an analytical tool in experimental data analysis. It is expected that the laboratory will impact all four years of the students training through various exercises.

Bhag S. Guru  
GMI Engineering & Mgmt Inst  
Flint, MI

CSI 8750931  
\$50,000

**"Improvement of an Undergraduate Electrical Machines Laboratory"**

This project will improve the electrical machines laboratory by adding six well equipped student experimental stations. The stations are to be equipped with "take-apart" machines which will allow the student to understand the physical construction of machines and its relation to physical and mathematical principles. Included in the stations will be most of the common types of machines and transformers. The related experiments will expose the students to both the static and dynamic behavior of electrical machines, and the deviations of dynamic behavior from theoretical performance based on simplifying assumptions.

Charles V. White  
GMI Engineering & Mgmt Inst  
Flint, MI

CSI 8750457  
\$22,100

**"An Undergraduate Quantitative Materials Measurement and Assessment Laboratory for the Manufacturing and Systems Engineering Program"**

A course, part of the new Manufacturing and Systems Engineering program, is being developed. This laboratory based course, Quantitative Materials Measurement and Assessment, will use the student's materials manufacturing

and statistics background to investigate state of the art materials measurement techniques and their applications in manufacturing process control. Students will test their knowledge of fundamental material phenomena through projects, utilizing computer aided measurement and analysis equipment to assess manufacturing process parameters. The equipment requested in this proposal is a state of the art high resolution, computer driven image analysis system, a dead weight loading micro hardness tester and precision diamond saw. Using this equipment, the students will learn that the control of in-process and final product quality begins with detailed knowledge of the material.

Robert D. Chute  
Lawrence Institute of Tech  
Southfield, MI

CSI 8750563  
\$22,494

**"An Undergraduate Electrical Machines Laboratory"**

This project will improve the quality of instruction in electromechanical device application, control and design. Seven Hampden machine stations will be added to the laboratory which presently supports three machine oriented courses. Included will be AC and DC variable powers sources, dynamometers, instrumentation and three phase and single phase machines which represent the basic machine types in general use today. This laboratory will form the basis of future control systems and special motor experiments.

Keshav S. Varde  
University of Michigan Dearborn  
Dearborn, MI

CSI 8750321  
\$40,012

**"Undergraduate Mechanical Engineering Laboratory Improvement"**

This project will upgrade the existing undergraduate mechanical engineering laboratories. Modern computer-controlled flow measurement, dynamometer, and pressure and temperature sensors will be integrated into new experiments. The experiments will cover the performance of heat pumps, internal combustion engines and metallurgical and structural components. Automation of a solar collector to determine absorption, heat losses, and collector efficiency is planned.

Kiumi Akingbehin  
James W. Knight  
University of Michigan Dearborn  
Dearborn, MI

CSI 8750293  
\$44,586

**"An Undergraduate Laboratory for Real Time Computing and Control."**

A real time computing laboratory will be set up under this project. It will provide the facilities to support a three

hour course for undergraduate engineering students in the fundamentals of real time computing and control. The laboratory will consist of a DEC Microvax II used as a software development station tied by Ethernet to another DEC Microvax II running Labstar real time software and acting as a controller of various equipment. Among the items to be controlled include a robot and computer numerically controlled machines. The system will include the capabilities to support up to twenty users developing software and then running their software individually through the controller.

Robert C. Pickett  
Bemidji State University  
Bemidji, MN

CSI 8750197  
\$16,310

#### **"Computer Assisted Engineering in an Undergraduate Engineering Physics Program"**

Two workstations will be added to the Engineering Physics program resulting in a three quarter sequence in computer aided engineering. The IBM PC/AT will be used to introduce the student to the ASSYST data acquisition and processing software, MICROCADAM mechanical design functions, and EE DESIGNER circuit simulation and design. A Motorola VME Module system will be used as a UNIX workstation to introduce finite element analysis via the CASA/GIFTS software. The result will be that the students are introduced to the workstation concept of engineering early in their course of instruction so that future courses can build on it.

Karl E. Burgher  
Montana College of Mineral Sci  
Butte, MT

CSI 8750031  
\$14,499

#### **"An Undergraduate Rock Fragmentation Laboratory for Mining Geophysical Engineers"**

A rock fragmentation and blasting laboratory will be installed at a local open pit mine for undergraduate mining and geophysical engineering students. Using a digital seismograph system, the students will enhance their understanding of blast design and the environmental effects of blasting, ground vibration and air blast control. The students will also gain experience in seismic exploration and the interpretation of three dimensional seismometry.

Alois J. Riederer  
Trenton State College  
Trenton, NJ

CSI 8750950  
\$45,683

#### **"An Undergraduate Automated Test and Measurements Laboratory"**

The objective of this project is to set up an exemplary automated test and measurement laboratory for under-

graduate education. It will include twelve workstations using IBM PC/AT level microcomputers controlling an array of Hewlett-Packard test instrumentation. Upon completion of this laboratory, all manual test and measurement instruments in the curriculum will be replaced by computer-controlled, multi-point instrumentation.

C. Stewart Slater  
Manhattan College  
Riverdale, NY

CSI 8750858  
\$21,504

#### **"Membrane Gas Separation Experiments for an Undergraduate Chemical Engineering Laboratory"**

The area of gas stream separation and purification has been revolutionized in the past decade by the development of hollow-fiber membrane systems. These new technologies are rapidly replacing antiquated ones and are being incorporated into the modern areas of chemical engineering. Applications are found in gas recovery for: waste gas streams, landfill gases, etc. and for gas generation and purification for: ammonia and petrochemical production, food processing and storage, semi-conductor manufacturing and the medical/health care industry. The present Chemical Engineering curriculum at Manhattan College will be supplemented by providing instruction and laboratory experience in gas separation by membrane processes. This will be accomplished through current course supplement, new course development and the introduction of new laboratory experiments covering the fundamentals of membrane gas transport and the operation of a hollow fiber membrane gas separator. Experiments on the laboratory-scale membrane system will illustrate the concepts of the driving forces for separation of gaseous components, overall material and component balances, separation factors in mass transfer, and temperature and residence time effects on gas separation. After completion of the course and laboratory developments, the student will have gained both theoretical and working knowledge of membrane processes used for gas stream separation and purification.

Alan H. Nye  
Rochester Institute of Tech  
Rochester, NY

CSI 8750703  
\$29,697

#### **"Development of an Undergraduate Laser Doppler Anemometry Laboratory"**

The objective of this laboratory is to introduce laser doppler anemometry to students taking a laser engineering course and courses in fluid dynamics. Two laser doppler anemometer systems will be acquired, one operating in the tracker signal processing mode, the other operating in the

counter signal processing mode. In addition, optics will be purchased to operate the anemometer in either the forward or back scatter mode. Experiments can thus be conducted in both air and water.

Lawrence W. Ward  
Webb Institute of Naval Architecture  
Glen Cove, NY

CSI 8750485  
\$15,726

#### **"Improvement of a Model Towing Tank for an Undergraduate Naval Architecture Laboratory"**

This project is to build a unique model towing tank facility by the addition of new transducers, data acquisition, recording and analysis equipment to an existing tank. The resulting equipment will allow students to run seakeeping and other experiments similar to those commonly done in industry. The new junior year engineering laboratory course is part of a major revision of the overall curriculum in the field of naval architecture and marine engineering.

Sanjiv Sarin  
North Carolina Agricultural  
and Technical University  
Greensboro, NC

CSI 8750634  
\$38,660

#### **"Enhanced Undergraduate Instruction in Graphics Science"**

This project is to create a computer graphics laboratory in the Department of Industrial Engineering. Twelve Tektronix graphics terminals and digitizing tablets will be connected to a host Vax computer. Three areas of graphics will be stressed. In addition to the conventional uses for computer graphics, communication and documentation, the idea of "ideation" will be explored. This idea is to give the engineering student a graphical tool to enable the student to visualize the design of an item. This should help the student to be more creative without spending a lot of time at the drafting board making paper images.

G. P. Mohanty  
Univ of N.C. Charlotte  
Charlotte, NC

CSI 8750412  
\$41,773

#### **"Undergraduate Laboratory Enhancement Through Computer Interactive Experimentation"**

Under this project, the junior mechanical engineering laboratories will be enhanced with the addition of interactive computer control of experiments. Experiments in three major stems of the program are envisioned. They are

mechanics/materials, thermal/fluids, and systems/controls. In the materials area, the student will be introduced to materials analysis techniques, the recording of x-ray diffraction patterns and their interpretation in terms of appropriate structural parameters. In the fluids area, measurements will be made in a duct of velocity and pressure drop distribution using computers to control fan speed and positioning of the pitot tube across the duct cross section. In the systems area, computer controlled experiments will demonstrate various ways to control an air engine and coupled tanks.

Ming-Shu Hsu  
University of Portland  
Portland, OR

CSI 8750487  
\$50,000

#### **"An Undergraduate, Interdisciplinary, Computer-Integrated Manufacturing Laboratory"**

An interdisciplinary, undergraduate, computer-integrated manufacturing (CIM) laboratory will be set up. The laboratory will include an Intellex six-axis robotic arm with an integrated vision system and a Brodhead-Garrett computer numerical control lathe and mill. The equipment will be interfaced to an IBM PC/AT and a Data General MV10000 mainframe for CIM experiments and system development. The laboratory will support an optional minor in computer integrated manufacturing for mechanical and electrical engineers in this growing area of need and interest.

Michael C. Mulder  
University of Portland  
Portland, OR

CSI 8750355  
\$50,000

#### **"An Undergraduate Systems Software Engineering Laboratory"**

The project will establish a network of workstations to support instruction in system software, software engineering and operating systems courses. A feature of the laboratory will be the creation of animated simulations of computer operations such as the instruction cycle, interrupt processing, time sharing and message passing. The animated simulations will bring motion to the static, abstract drawings presently put on the blackboard and on transparencies. The simulations will allow student interactions. The students will be able to view the dynamics of computer operation at various levels, interrupt the process, or make changes in the external conditions and see the changes in computer operations.



Jeffrey C. Evans  
Bucknell University  
Lewisburg, PA

CSI 8750157  
\$26,807

#### **"Modernization of the Undergraduate Geotechnical Engineering Laboratory"**

Under this project, Bucknell University will modernize its geotechnical laboratory within the civil engineering department. Equipment will be obtained to measure the shear strength of soil and rock in triaxial shear. Triaxial control panels and triaxial cells will allow the students to measure and control the externally applied total stresses, the pore water pressure, specimen volume change and the stress path. Consolidometers will be used to measure the consolidation properties including preconsolidation pressures and the time rate of consolidation of soils. This laboratory modernization will permit students to conduct laboratory tests on a wide range of soil types with up-to-date equipment.

James N. Zaiser  
William J. Snyder  
Bucknell University  
Lewisburg, PA

CSI 8750917  
\$23,630

#### **"Velocity Measuring Equipment for the Undergraduate ThermoFluids Laboratory"**

A laser doppler velocimeter will be installed in the thermo-fluids laboratory. This will enable the students to make non-invasive measurements of fluid flow in generalized test sections. Students from the fields of mechanical, electrical, civil and chemical engineering will be able to perform open ended experiments of varying degrees of complexity. Typical experiments planned are measurement of boundary layer velocity profiles in drag reduction, measurement of fluid velocities in radial and sonic flow, and measurement of velocities in a pump turbine test stand.

Samuel L. Hazen  
Gannon University  
Erie, PA

CSI 8750876  
\$46,170

#### **"Development of an Undergraduate Computer-aided Design and Test Laboratory"**

In this project, a modern, computer-aided design and test laboratory will be constructed. It will include ten integrated electrical engineering workstations consisting of an interconnected IBM PC/XT with Hewlett Packard electronic benches attached. These workstations will be used to teach modern computer-aided testing, measurements

and experimentation in circuits, electronics and advanced laboratories. The result is expected to be a significant improvement in the laboratory education of electrical engineers.

H. Richard Feller  
Richard A. Youchak  
University of Pittsburgh—Johnstown  
Johnstown, PA

CSI 8750050  
\$13,912

#### **"A Computerized Data Acquisition System for an Undergraduate Engineering Technology Strength of Materials Laboratory"**

A Measurements Group 4000 data acquisition system will be added to the strength of materials and advanced structures laboratory. Engineering technology students will be able to rapidly gather data on yield points, moduli of elasticity, and ultimate stresses. In addition, with the computer taking data rapidly, the students will be able to study the statistical variation of the measurements and the effect of changing variables.

Stephen M. Platt  
Swarthmore College  
Swarthmore, PA

CSI 8750799  
\$19,738

#### **"A Graphics Workstation Laboratory for Upper-Level Undergraduate Engineering Education"**

The Engineering Department of Swarthmore College will create a laboratory facility to introduce workstation and computer graphics as integral parts of the engineering curriculum. This state-of-the-art graphics environment will support upper level courses in the fields of Civil, Mechanical, Electrical and Computer Engineering. Apollo workstations will be used with integrated graphics capability. This experience at the undergraduate level will help the students understand how engineering is done in practice.

John W. Hoopes, Jr.  
Widener College  
Chester, PA

CSI 8750339  
\$14,425

#### **"On-Line Analysis for an Undergraduate Chemical Engineering Laboratory"**

This project will add automatic computer control to a laboratory distillation column with on-line sampling and analysis. A continuous refractometer and gas/liquid chromatograph equipped for direct process analysis, sample-conditioning, and meter/injection systems will complete

the feedback loop through an IBM PC to an existing computer. The resulting equipment will provide up-to-date instruction in the operation and control of batch and continuous distillation processes.

John E. Molyneux  
Timothy J. Singler  
Widener College  
Chester, PA

CSI 8750611  
\$33,700

**"Open Circuit Low Turbulence Wind Tunnel with Three-Component Sting Balance for an Undergraduate Fluid Dynamics Laboratory"**

This project will add a 20" x 28" throat, open cycle wind tunnel and sting balance to the mechanical and civil engineering laboratory. The new tunnel will support a variety of experiments in convective heat transfer that are not supportable with the existing closed cycle tunnel. In addition, the increased size and speed will provide access to high Reynolds number regimes where the characteristic differences between laminar and turbulent boundary layers can be elucidated. Besides strengthening the existing laboratory course, the department plans to introduce a new course in the area of applied fluid dynamics which will be supported by the new machine.

Donald Glaser  
Christian Brothers College  
Memphis, TN

CSI 8750504  
\$50,000

**"Undergraduate Electrical Engineering Student Development Workstations"**

A modern microcomputer laboratory consisting of nine stations will be set up to complement courses in microcomputers and microprocessor interfacing. Each workstation will consist of an IBM PC/AT and a Motorola 68000 emulator system. Students will be taught the whole concept of microcomputers and how they interact with real world devices, not just programming in either a high level or assembly language. The system as envisioned will also allow relatively inexpensive updating as more modern chips become available.

G. Reed Marchant  
Weber State College  
Ogden, UT

CSI 8750603  
\$50,000

**"Upgrading an Undergraduate Engineering Technology Process Instrumentation and Control Laboratory"**

This project is to set up a process instrumentation and control laboratory within the industrial automation labo-

ratory. Included will be a process control simulation system, consisting of simulators, PID controllers, discrete controllers, programmable logic controllers, and process simulation microprocessors. The laboratory will use industrial grade instrumentation and IBM PC compatible computers to insure maximum versatility and compatibility. The students will thus learn control techniques ranging from PID controllers to discrete systems control using equipment which is found in industry.

Gregory D. Wight  
Norwich University  
Northfield, VT

CSI 8750154  
\$9,160

**"An Undergraduate Environmental Monitoring Laboratory Data Acquisition System"**

The objective of this project is to upgrade the environmental monitoring laboratories with the addition of computer controlled data acquisition and statistical analysis. This upgrade will result in laboratory experiences for the student which are more in agreement with current practice in industry and the regulatory agencies. Two laboratories will be upgraded-the Air Pollution Laboratory and the Water Chemistry Laboratory. Extensive instrumentation already exists, and the added computer equipment will facilitate the introduction of statistical analysis to the laboratory exercises and supplement a recently added course in mathematical statistics.

Michael A. Brzoska  
Eastern Washington University  
Cheney, WA

CSI 8750650  
\$8,052

**"An Upgraded Undergraduate Materials and Mechanical Engineering Laboratory"**

A Hewlett Packard 310 computer and data acquisition system is being added to the existing materials testing and fluids mechanics laboratory. Students in the Department of Technology will conduct experiments in fan performance measurement, flow blockage, and tensile measurements. In a unique experiment structure the students will study the principles of computer aided data acquisition first. Using existing software, the students then will conduct experiments in measuring the performance of fans, to include computer calculated performance curves. Finally, the students will be given an open-ended experiment to design, write the software and prepare computer generated reports. This structure, covering experiments from "canned" to open-ended, will provide the student with an excellent understanding of computer-aided experimentation.

Ferd H. Mitchell  
Gonzaga University  
Spokane, WA

CSI 8750725  
\$50,000

**"A Multiple Local Area Network for Undergraduate Engineering Education in Computer-Integrated Design and Manufacturing"**

This project will integrate existing computer-aided design (CAD) and computer-integrated manufacturing (CIM) facilities with a multiple local area network resulting in an innovative undergraduate interdisciplinary laboratory. The laboratory will use the new Manufacturing Automation Protocol (MAP) to control a hybrid electronics manufacturing facility. Both electrical and mechanical engineering laboratories will provide the student experiences in the interrelationships among engineering theory, the laboratory, design and manufacturing.

Gary J. Erickson  
Seattle University  
Seattle, WA

CSI 8750312  
\$49,150

**"An Undergraduate Very Large Scale Integrated Circuit Design and Test Laboratory"**

A laboratory with four Sun Microsystems 3/110L microcomputers and peripherals will be integrated into the three course sequence in VLSI design. After a course in semiconductor materials, the students will be introduced to VLSI circuit design using modern workstations. As part of the laboratory, the students will design a circuit which will be fabricated at a foundry. Finally, the students will test their designs using automated test equipment.

Rolf T. Skrinde  
Seattle University  
Seattle, WA

CSI 8750571  
\$7,682

**"Enhancing Undergraduate Laboratory Experiences in Wastewater and Hazardous Waste Treatment"**

In this laboratory project, students will use an Activated Sludge Pilot Plant to study the activated sludge process for treating non-hazardous and hazardous wastes and the anaerobic decomposition of the sludge produced. The laboratory will run concurrently with the lecture classes, thus clarifying the student's understanding of the processes involved. Using teaching microscopes, the students will observe waste water biota under various conditions of substrate metabolism. They will be able to observe which kind of

sludge works well on given sewage feeds and settles well. Analysis with a gas chromatograph of the off-gas produced during anaerobic digestion of the sludge will allow the student to evaluate the kinetics and biological reactions involved in each treatment operation.

Edward J. Bauman  
Seattle Pacific University  
Seattle, WA

CSI 8750819  
\$44,964

**"Undergraduate Instrumentation and Design Computer Workstations"**

The goal of this project is to provide electrical engineering undergraduate students with a unique, low cost and modern approach to laboratory instrumentation, circuit and system design. A prototype computer workstation has been created that allows the students to quickly access hardware and software programs so they can do both analysis and design of circuits and systems. The equipment to be purchased will extend the capabilities of the workstations and provide an adequate number to service the entire electrical engineering curriculum.

A/D and D/A converters and software added to the personal computers will allow real time digital control, data acquisition and signal processing. Digital scope interfaces will make the computer a storage scope and will allow signal analysis via computer programs. A logic interface turns the personal computer into a powerful, menu driven logic analyzer. With powerful software design tools and interface hardware the students can design, simulate, and test circuits and systems from the computer workstation.

Nader Ghafoori  
St Martin's College  
Lacey, WA

CSI 8750674  
\$29,632

**"Improvement in Engineering Education through Computer Aided Design and Drafting"**

The civil engineering program is being modernized and strengthened with the introduction of computer-aided design and drafting. The system is being used in varying degrees in different courses ranging from basic technical drafting to courses in structural mechanics. The software will give the students the opportunity to use state-of-the-art techniques in the calculation and design of structural building systems. Finally, the laboratory will support the surveying courses eliminating many of the hand calculations now required.



## INTERDISCIPLINARY

Murray D. Dailey  
California State Univ Long Beach  
Long Beach, CA

CSI 8750058  
\$23,053  
Environmental

### **"Hydrowinch and Automated Probe Sampling System for an Undergraduate Ocean Studies Laboratory Aboard a Six Campus Consortium Vessel"**

A multi-channelled, electromagnetic cable winch with automated multi-parameter probe sensors will be used by undergraduate students from six southern California state universities aboard the Southern California Ocean Studies Consortium teaching vessel. With this winch and instrumentation the laboratory exercises will expose students to the application of current principles and analytical techniques. The equipment makes possible a continuity in the laboratory exercises by eliminating the need to return to the home campus for data analyses. This provides the students with a much needed "hands on" experience with automated instrumentation. This type of experience with this equipment in the "at sea" laboratory enhances the preparation of prospective graduates for future professional work.

Dallas D. Rhodes  
Whittier College  
Whittier, CA

CSI 8750314  
\$14,200  
Other NEC

### **"Photographic Image Analysis by Undergraduates in the Natural and Social Sciences"**

The project will provide students in the natural and social sciences with experience in detailed image analysis. The instrumentation will allow Whittier College to make full instructional use of the Fairchild Aerial Photography Collection—a unique archive of historical (1928-1964) aerial photographs. Because of the age and breadth of photography in the collection, both major and non-major students in several disciplines can use it for laboratory, class, and research projects. Geology students will use aerial photographs and maps to show the progress of natural processes and analyze geological features. Students in biology will be able to map vegetation, habitats, or particular environments and show how they have changed in response to natural events (e.g., fire) and changing land use. Sociology classes will analyze processes of urban development and the distribution of social and ethnic groups in terms of their geographic location in the natural and man-made landscape. The major piece of equipment to be purchased is a Bausch & Lomb Zoom Transfer Stereoscope. This instrument allows all types of images to be compared by carefully match-

ing scales and removing distortions, and information on an image can be transferred to special-purpose maps. A digitizer tablet with appropriate software and a computer will be used to convert the graphical data to numerical form for image and statistical analyses.

Peter Sereico  
University of New England  
Biddeford, ME

CSI 8750719  
\$11,911  
Ecology

### **"Experiments in Receiving Water Analysis"**

As a part of an Environmental Analysis major a new laboratory course is being developed in "Receiving Water Analysis." Experiments are being developed and tested involving measuring the amount of dissolved oxygen in different situations and to evaluate parameters such as, reaeration constants, decomposition constants, and diffusion and dispersion constants. The Ion Chromatograph is being used to monitor inorganic ions such as nitrates and phosphates to evaluate empirical constants for use in classical water quality mathematical models. A laboratory manual for the course is being planned to indicate the possibilities these experiments provide for students in environmental studies.

Esther J. Gibbs  
Goucher College  
Towson, MD

CSI 8750765  
\$22,107  
Ecology

### **"An Atomic Absorption Spectrometer for Undergraduate Environmental Studies in Biology and Chemistry"**

Goucher College will buy an atomic absorption spectrometer (AA). The AA will be used in a variety of upper level chemistry and biology courses, and it will also be the major piece of equipment used in six week intensive projects, where chemistry and biology students join forces to investigate the uptake of heavy metals in aquatic organisms. This project will simulate the interaction of biologists and chemists typical of research or industrial settings and will require both independence and communications skills. This project may serve as a model for cooperative teaching between disciplines where shared expertise is focused on different aspects of the same question.

After receiving background in toxicology and instrumental analysis respectively, the biology and chemistry students will join forces. Biology students will formulate the basic questions about metal uptake and toxicity and then

consult their chemist peers to develop the experimental design and analytical protocol for metal analysis in tissues using the AA. The biology and chemistry students will then analyze the samples and interpret the data together. This is an excellent place for students to experience the benefits of modern computer interfaced instrumentation, for it will greatly affect their ability to answer scientific questions. The sensitivity of the AA will permit detection of trace levels of metals in the environment or in tissues. Sample automation will allow enough samples for thorough data analysis, which will in turn be greatly facilitated by the onboard graphics and data management software of the AA.

Paulette M. Peckol  
Five Colleges Inc  
Amherst, MA

CSI 8750160  
\$30,115  
Ecology

#### **"A Boat Equipped with Survey, Sampling, and Analysis Equipment for a Five College Undergraduate Marine Sciences Program"**

Five Colleges, Inc., a consortium comprised of Amherst, Hampshire, Mount Holyoke, Smith and the University of Massachusetts, will strengthen its interdisciplinary program in Coastal and Marine Sciences. The goal is to enhance the field-research portion of several courses and independent student projects by improving access to marine habitats and by removing the restrictions imposed by the lack of essential, specialized equipment. Specifically, the consortium will purchase a boat which is the laboratory from which students will conduct nearshore and open water experiments. Surveying equipment will permit students to generate accurate, on-site topographic maps of salt marsh and rocky intertidal habitats; coring equipment will enable students to visualize the dynamic processes molding the coastline, recorded in underlying peat and sediment layers. Other equipment, including trawls, gill net, plankton nets, field balance, underwater camera, light meter, and oxygen meter, will provide training in contemporary sampling methodology, and enable students to design sophisticated field experiments. Improving the Coastal and Marine Sciences Program, by taking advantage of the new teaching opportunities represented in modern, analytical field equipment, will make the program more effective in preparing students for successful professional study in marine sciences.

David P. Dethier  
Henry W. Art  
Williams College  
Williamstown, MA

CSI 8750838  
\$27,723  
Environmental

#### **"Meteorologic and Hydrologic Instrumentation for Undergraduate Field Work"**

Meteorologic and hydrologic instrumentation will be used to improve field laboratories and computer studies in Ge-

ology and Biology courses at Williams College. The instruments will be used at a weather station in Hopkins Memorial Forest, an experimental forest managed by Williams College, and the focus of field classes and independent research in the environmental sciences. The sensors and data loggers will be installed at the existing weather station, and three portable meteorologic and hydrologic stations will be assembled for use at remote sites. Use of state-of-the-art instruments which encode data in digital format will permit easy transfer of weather and hydrologic data to computer files.

Portable instrumentation will significantly improve the quantity and quality of data collected in the field and used in required courses such as Geomorphology, Environmental Biology, and Communities and Ecosystems. Computer files of weather and hydrologic data will also be used to develop new field and computer labs in elective courses such as Weather and Climate and Computers in Geology. Biology and Geology majors most likely to go to graduate school, those students involved in field studies for senior honors theses, will gain invaluable experience using modern instrumentation and computer reduction of data from their field sites.

David J. Matty  
Central Michigan University  
Mount Pleasant, MI

CSI 8750320  
\$28,750  
Geology

#### **"Courses and Development of a New Course in Analytical Scanning Electron Microscopy and Image Analysis"**

Students in geology and biology have been using electron microscopy for morphological studies of biological and geological materials. By adding a quantitative microanalysis system with digital X-ray and video image processing and analysis systems the students are being exposed to state-of-the-art analytical and image processing. A new course is being developed between the biology and geology departments to focus on the underlying theory and diverse applications of analytical scanning microscopy and image processing analysis. Students are receiving hands-on experience through extensive laboratory work. In addition students in mineralogy and petrology are doing new experiments that are made possible by the expanded system. The quantitative microanalysis software is making it possible for the students to do Bence-Albee analyses for geological samples and to do statistical and mathematical analyses for least-squares filter fit, intensity ratio calculations and multiple point analysis.

|                         |               |
|-------------------------|---------------|
| Theodore P. Aufdemberge | CSI 8750082   |
| Concordia College       | \$6,948       |
| Ann Arbor, MI           | Environmental |

**"Computerization of Concordia's Introductory Physics/Earth Science Laboratory"**

Concordia College will improve the quality of physics and earth science instruction by introducing computer controlled experiments. These will increase the accuracy and precision of data gathered in experiments, and speed the calculations needed to convert raw data into usable data, so that the time normally spent on these activities can instead be used in analyzing the data and drawing conclusions. The major purchases will be two Apple computers, interface cards, sensors, a printer, and a plotter to provide hard copies of the data gathered and manipulated. The sensors will be used to measure time intervals, temperatures, frequencies, and weather phenomena.

Most of the students taking physics and earth science courses at Concordia are studying to become elementary and secondary school teachers.

|                               |             |
|-------------------------------|-------------|
| William T. Corcoran           | CSI 8750709 |
| Southwest Missouri State Univ | \$37,878    |
| Springfield, MO               | Geography   |

**"Improving Undergraduate Cartography Education with Graphics and Data Base Systems"**

Cartography, the art and science of map making is rapidly converting to computerized, digital data bases and highly interactive computer graphic displays. The Cartography and Map Technology Program is taking significant steps towards computerizing the map-making process taught to students. A mini-computer graphics system is being used in two separate ways: for teaching interactive map design; and in teaching data base concepts necessary in handling map data bases. The system includes graphics work stations with digitizers and controllers as well as a color hardcopy device to print the maps being produced. Since cartographic data represents some of the largest, most complex, and rapidly changing data bases, an advanced graphics computer system is helping students acquire the theoretical and practical knowledge necessary for dealing with mapping problems in the future.

|                         |             |
|-------------------------|-------------|
| James R. Spotila        | CSI 8750426 |
| SUNY College at Buffalo | \$46,872    |
| Buffalo, NY             | Ecology     |

**"Improving an Undergraduate Interdisciplinary Aquatic Science Program on Lake Erie and the Niagara River"**

An interdisciplinary program in aquatic science focused on the Great Lakes ecosystem is being improved by this

project. Using a 37 ft. research vessel, smaller boats and a field station on 3.5 acres of land at the mouth of Lake Erie a group of faculty from the Biology and Geoscience, Physics and Interdisciplinary Science (GPIS) Departments are teaching undergraduates how to conduct modern scientific research on freshwater aquatic systems. Both formal course work and independent student research projects are involved. Scientific equipment acquired is being used for quantitative experiments in aquatic ecology, microbiology and sedimentology. Unique research and instructional opportunities are being provided for undergraduates and high school teachers. Major items of equipment include a portable photosynthesis system for measuring primary productivity of emergent aquatic plants, an epifluorescence microscope for enumerating aquatic microorganisms, and a SediGraph 5000ET for textural analysis of fine grained sediments.

|                           |                   |
|---------------------------|-------------------|
| B. L. Redmond             | CSI 8750376       |
| SUNY College at New Paltz | \$46,775          |
| New Paltz, NY             | Multidisciplinary |

**"Upgrading an Interdisciplinary Electron Microscopy Facility for Undergraduates"**

SUNY College at New Paltz will improve an undergraduate electron microscopy program for the Departments of Biology, Chemistry, Geology, and Physics, as well as a newly organized School of Engineering. The college will purchase a Scanning Electron Microscope (SEM), model JSM-840 manufactured by JEOL. The primary application of the SEM will be to shift from the old, descriptive, morphological applications to current, quantitative, analytical uses of the SEM. This will impact on 1) E.M. courses for science and engineering majors; 2) the undergraduate research program; 3) programs for non-majors, specifically, the general education program; and 4) community outreach to other colleges, community colleges and high schools. This project will upgrade a program in electron microscopy, and provide undergraduate science, engineering and science education majors with the necessary technical background and analytical skills to be competitive for graduate programs at major universities or to go directly into the scientific workforce in science, medicine, industry or public education.

|                     |                   |
|---------------------|-------------------|
| Mitchell I. Chernin | CSI 8750783       |
| Bucknell University | \$43,462          |
| Lewisburg, PA       | Multidisciplinary |

**"A Laboratory Course at the Interface of Chemistry and Biology"**

A research course is being taught jointly by members of the Biology and Chemistry Departments, that introduces



students to the theoretical implications and practical applications of various techniques at the interface of chemistry, biochemistry and molecular biology. This is particularly important in light of the current and continued emphasis on biotechnology. A work station approach, utilizing spectrophotometric, chromatographic and electrophoretic equipment in an inter-related fashion is the primary focus of the course. Students are being required to isolate, purify and characterize specific proteins and nucleic acids using the equipment. The students are being exposed to a variety of scientific perspectives and techniques as they are actually being carried out in laboratories. The students are being given the opportunity and the training necessary to apply these techniques to the problems encountered in their own research endeavors.

Sidney Pollack  
Owen A. Moe, Jr.  
Lebanon Valley College  
Annville, PA

CSI 8750769  
\$26,107  
Biology

#### **"Ultracentrifuge and Electrophoresis Equipment for Undergraduate Instruction in Genetics, Molecular Biology, and Biochemistry"**

Lebanon Valley College will strengthen its major degree programs in biochemistry and biology by incorporating a new experiment into an existing genetics course to demonstrate the principles of ultracentrifugation and its application to DNA purification; introducing a new advanced course in molecular biology; and implementing a new project-oriented sequence of experiments in an existing biochemistry laboratory course. In order to carry out this plan, Lebanon Valley College will acquire a Preparative Ultracentrifuge, Equipment for DNA Electrophoresis, a Microcentrifuge, and a Biological Safety Hood. The increasing importance of molecular genetics in both basic and applied biochemical research makes the introduction of its concepts and methodologies into the curriculum necessary.

G. Samuel Lightner  
Westminster College  
New Wilmington, PA

CSI 8750952  
\$9,786  
Multidisciplinary

#### **"The Addition of Laser Techniques to Advanced Laboratories in Physics and Chemistry"**

Lasers are versatile tools in the physical sciences that are able to accomplish tasks that no other tool can achieve. The advent of inexpensive, easy-to-use and reliable dye lasers makes it possible to introduce a variety of experiments into physical science programs at the undergraduate level. Students in the Departments of Physics and Chem-

istry will use the lasers and auxiliary detection equipment to perform a variety of experiments including: the measurement of the speed of light in air and liquids, studies of one and two photon fluorescence, the use of Raman scattering to study the structure of molecules, and the detection of subnanogram amounts of toxic aflatoxins from grain samples. The experiments developed in this project will be made available to other schools to extend the impact, and prepare more students for careers in the physical sciences.

Daniel D. Von Riesen  
Roger Williams College  
Bristol, RI

CSI 8750134  
\$6,400  
Multidisciplinary

#### **"Updating the Biology and Chemistry Curricula with a High Performance Liquid Chromatograph"**

A more comprehensive and current approach to the teaching of undergraduates in Biology and Chemistry is being made possible with the addition of a High Performance Liquid Chromatography System (HPLC). HPLC is recognized as an instrumental technique of major importance in both biology and chemistry. The project director, who has been actively involved in the development of HPLC instrumentation and software, along with his colleagues, is revising the curriculum in both the biology and chemistry programs so as to provide students with practical, hands-on experience with this fundamental instrumental technique. Seven courses in the two departments are being affected by the project, as well as the independent study and undergraduate research programs. The HPLC system is complementing existing laboratory instrumentation and computer equipment, opening up new learning opportunities.

Lynn Rosenthal  
College of the Virgin Islands  
Charlotte Amalie, VQ

CSI 8750928  
\$17,510  
Multidisciplinary

#### **"Computer Graphics Laboratories for Dynamic Modeling and Visualization of Mathematical and Scientific Systems"**

The College of the Virgin Islands will help its science and mathematics students better to visualize mathematical functions and relationships, and develop a quantitative intuition for the dynamic behavior of systems and the effects of changes to systems, cognitive skills which are difficult to impart in classroom situations. The use of more powerful hardware with good graphics capabilities and an icon user interface, coupled with availability of general tools for student exploration, provides an environment where these

skills can be acquired. This project will provide student labs equipped with such facilities for use in all science and mathematics programs, and enable the College to enrich its science students' learning experiences and increase their exposure to new computing techniques. The college will purchase Macintosh graphics computers, networking hardware, and software.

James M. Stroh  
Evergreen State College  
Olympia, WA

CSI 8750411  
\$42,996  
Multidisciplinary

**"Upgrading the Undergraduate Interdisciplinary Science Programs with X-Ray Microanalysis and Scanning Electron Microscopy"**

This project will upgrade and expand the undergraduate curricula in biological and earth sciences through the acquisition of an energy dispersive X-ray scanning electron microscope. The microscope will be used for class laboratory exercises in intermediate and advanced level environmental science (biology and earth sciences) and "laboratory" biological science programs, and also for independent undergraduate research projects in these fields. Through use of the instruments, students will be able to observe examples of phenomena and principles discussed in texts, will learn widely used modern instrumental techniques, and will be enabled to pursue independent research using these techniques.

Keith O. Berry  
University of Puget Sound  
Tacoma, WA

CSI 8750284  
\$50,000  
Multidisciplinary

**"Multidisciplinary X-ray Laboratory"**

The Chemistry, Geology, and Physics departments are establishing a new X-ray laboratory. Instruments in the laboratory (X-ray diffractometer for powders and X-ray spectrometer) will be used to support several courses offered in the undergraduate curriculum. In addition, the instruments are being utilized by both faculty and students for support of the undergraduate research program at this institution. The departments are committed to educating students through hands-on experiments, utilizing a variety of instruments. Rather than through a single course in which the instruments are being used, an effort is being made to integrate applications of X-ray methods throughout the entire curriculum. A Phillips PN1430 spectrometer coupled with the Phillips PW1840 diffractometer offered the greatest cost advantage to the university. The system includes a matched computer system interfaced to the instruments.

Robert J. Eierman  
University of Wisconsin Eau Claire  
Eau Claire, WI

CSI 8750810  
\$12,807  
Multidisciplinary

**"Multidisciplinary Use of an Atomic Absorption Spectrometer in Undergraduate Chemistry and Geology"**

The University of Wisconsin—Eau Claire will introduce the powerful analytical technique of atomic absorption spectrometry to chemistry and geology students at the undergraduate level. A flame atomic absorption spectrometer, including an electrothermal atomizer, will be acquired and installed in place of the present, obsolete instrument. The new instrument will be introduced and used in two chemistry laboratory courses, Quantitative Analysis and Instrumental Analysis. Applications will include comparison of this instrument with molecular absorption instruments and a simple analysis in Quantitative Analysis and a thorough familiarization and investigation of major instrumental parameters in Instrumental Analysis. Elemental analyses are critical to the geological sciences so it is necessary to teach this widely used technique. Atomic absorption analyses will be done in at least three geology courses including Geochemistry, Economic Mineral Deposits, and Chemical Hydrogeology. In addition, the instrument will be used extensively in research projects in both departments.

Peter A. Nielsen  
University of Wisconsin Parkside  
Kenosha, WI

CSI 8750162  
\$34,687  
Multidisciplinary

**"Acquisition of X-ray Powder Diffraction Facilities and Upgrading of the Undergraduate X-Ray Scattering Laboratory"**

Under this project, a Huber powder goniostat and counter-tube attachment, and a Rigaku D/max IIVB X-ray generator with vertical goniometer mount will be purchased. This instrumentation will serve the broad purpose of teaching geology, physics, and chemistry undergraduate students the fundamentals of photon counting and signal processing, interfacing of instruments to computers, and X-ray crystallographic techniques. It is our perception that undergraduate programs in geology, physics, and chemistry in general suffer from inadequacy in the teaching of instrument interfacing, computer simulation, and structure determination. All of these aspects of experimentation are important to the education of undergraduate geologists, physicists, and chemists so they can pursue graduate studies or obtain meaningful employment. The requested equipment will be used in mineralogy, petrology, soils, glacial geology, environmental geology, physical chemistry, chemical instrumentation laboratories and in selected independent studies and senior thesis research projects in geology, physics, and chemistry.

## MATHEMATICS

Eugene A. Herman  
Grinnell College  
Grinnell, IA

CSI 8750715  
\$50,000

### **"Using Powerful Computer Software in a Laboratory Environment to Help Undergraduate Students Develop Mathematical Insight"**

The mathematics department at Grinnell College will develop a Mathematics and Computing Lab in which students use software packages that strengthen mathematical intuition and insight by representing mathematical ideas and objects (such as functions, matrices, differential equations, infinite series, computer programs, and algorithms) in a variety of forms that permit them to be manipulated and experimented with. The objective is to promote the kind of direct acquaintance with and understanding of these mathematical objects that professional applied mathematicians and computer scientists have traditionally acquired through long experience or unusual insight, and have more recently begun to develop more quickly through software tools. Specifically, the software will include packages for graphical display and manipulation of functions and algorithms, numerical approximation, and symbolic algebra.

The computer system used will consist of a Sun 3/160S file server, a large disk and tape system, and eight Sun 3/50M work stations. The workstations in the lab will be connected to a departmental local area network, which will give faculty and students equal access to all resources and enable them to exchange information from the lab, faculty offices, and classrooms.

Robert J. Weaver  
Harriet Pollarsek  
Mount Holyoke College  
South Hadley, MA

CSI 8750848  
\$36,525

### **"Computer Laboratory for Mathematical Experimentation"**

The mathematics department at Mount Holyoke College will purchase a micro VAX-II, peripherals, and software in order to establish a mathematics computer laboratory to be used in three ways. First, students in a course, required of majors, called Laboratory in Mathematical Experimentation, will investigate mathematical problems which are best attacked using a computer. Examples of these are topics in chromatic polynomials and unimodality; topics dealing with prime numbers; randomness; chaotic dynamical

systems; the Mandelbrot set. This laboratory will force students to come to grips with mathematical ideas through experimentation and conjecture, ensure some proficiency with the computer, and help foster precise thinking and writing. Second, in advanced courses students can build on their experience in the laboratory to use the computer more easily to work on interesting problems. Third, in senior independent work the availability of the computer will increase the number and sophistication of independent projects available to a student, and she will have had considerable experience so that she can start the project at a higher level.

Jack Goldfeather  
Carleton College  
Northfield, MN

CSI 8750099  
\$39,430

### **"An Undergraduate Computer Graphics Laboratory for Mathematics and Computer Science"**

Under this project, Carleton College will develop a computer graphics laboratory using a MicroVAX II computer, a high resolution display and five low resolution terminals. The laboratory will support both computer graphics courses and independent student study in this emerging area. Two student research projects are contemplated. One is to produce three dimensional images from two dimensional images representing cross-sectional slices of biological specimens. The other is to produce three-dimensional, animated sequences. Emphasis in the courses and laboratory will be on the mathematics, physics, and computer science theories that form the basis of modern computer graphics.

Russell Dubisch  
Siena College  
Loudonville, NY

CSI 8750276  
\$28,610

### **"The Development of a Facility for Symbolically-Aided Instruction in Mathematics and Physics"**

Siena College will undertake the development and implementation of a computer-assisted instructional system in mathematics and physics with high-level symbolic capabilities. The system will utilize a Micro VAX II with SMP, a programmable symbol-manipulation program which will enable student users to communicate with the computer at an algebraic level. Software development will be carried



out by Siena's Software Engineering class, under supervision of the principal investigator and other involved faculty. The facility will be integrated into the general physics and introductory mathematics courses, and will be used secondarily by students in the advanced physics courses.

Zaven A. Karian  
Denison University  
Granville, OH

CSI 8750137  
\$36,000

#### **"The Use of Computer Algebra Systems in Teaching Introductory Calculus"**

This project will enhance lower-division students' understanding of the basic concepts of calculus and increase the likelihood that these concepts will be properly applied in new situations. The project will incorporate the use of a Computer Algebra System (CAS) to carry out complex computational and symbolic operations, thereby freeing time for students to better understand and apply the rich collection of ideas embodied in calculus. Many applied mathematicians and engineers have used CAS in their work, but the computer power required to sustain CAS has, until recently, prohibited its use in most academic environments. Denison University will purchase two Micro VAX II computers with 20 attached terminals on which to run Maple, a CAS software package. This configuration is well within the capability of the faculty and one that meets the needs of the students. This project is especially important now, when many mathematicians are calling for attempts to make calculus more "lean and lively" and to interest more students in mathematics.

Carol Jones  
Univ of Houston Downtown College  
Houston, TX

CSI 8750352  
\$42,000

#### **"Integration of Microcomputer-based Instruction into Business Statistics Courses"**

This project will support instrumentation in the Applied Mathematical Sciences Department of an open-admissions college. A classroom will be equipped with twenty-five networked IBM-PC (or IBM compatible) microcomputers and a large scale projection screen for demonstration purposes. The equipment will be used in two junior level statistics courses which are required of business majors. Students will encounter daily assigned classroom problems dealing with decision-making situations which require statistical analysis and interpretation of computer output. Solutions will be worked out on computers (two students per machine), as in a lab. Mathematically-shy business students will have a greater appreciation of statistical concepts and their applications to real world problems, more experience in dealing with the popular IBM-PC machinery and increased interest in pursuing optional senior level math courses in the area of the decision sciences. Business students, who represent fifty-eight percent of UH-Downtown's 1986 graduating class, will receive enhanced training in quantitative methods. Ultimately, other faculty will be encouraged to use this instructional lab for courses in computer science, numerical methods and calculus.

## **PHYSICS**

Peter J. Pella  
Hendrix College  
Conway, AR

CSI 8750232  
\$7,250

#### **"High Resolution Gamma Spectroscopy and X-ray Fluorescence for the Advanced Undergraduate Laboratory"**

The Department of Physics will purchase a hyper-pure, intrinsic germanium detector and a MCA-card for an IBM-PC. The equipment will be used to strengthen the department's advanced laboratory program by introducing experiments in neutron activation, X-ray fluorescence and environmental studies.

Steven W. McCauley  
California State Polytech Univ  
Pomona, CA

CSI 8750530  
\$34,172

#### **"Modern Optics and Spectroscopy for Undergraduates"**

Modern optics is an area of increasing importance to the economy. The Physics Department at Cal Poly Pomona will enhance their program in optics and spectroscopy by purchasing a nitrogen-pumped dye laser and nanosecond resolution detection system. This laser system will be used in the optics class to teach students principles of laser operation and to provide a source for non-linear optical effects. The laser system will also serve as a resource for the Physics majors in the advanced laboratory series in order to enable students to do advanced experiments and re-

search projects in optical pumping, resonance transfer of energy in optical systems, non-linear optics, the measurement of fluorescence lifetimes, Raman spectroscopy, thermal lensing experiments, and photochemistry. The short pulse duration, high power, and variable wavelength of the dye laser will make it a versatile and reliable light source for undergraduate optics at all levels.

Richard C. Haskell  
Harvey Mudd College  
Claremont, CA

CSI 8750246  
\$15,873

#### **"Introduction of Computer-Aided Data Acquisition and Analysis in Advanced Undergraduate Physics Instructional Laboratories"**

Computers have revolutionized experimental methods in physics, yet physics students have not had the equipment to use computers for data acquisition and analysis. The Physics Department at Harvey Mudd will integrate computer systems into three laboratory experiments. The first experiment is in Fourier transform spectroscopy; it requires extensive computation using the fast Fourier transform algorithm. The second is a photon statistics experiment, which requires the acquisition and analysis of large quantities of data. The third is an atomic spectroscopy experiment which relies upon computer-aided data acquisition to eliminate systematic drifts while increasing the signal-to-noise ratio. All three experiments depend critically on the judicious use of computers. In order to equip these experiments, three DEC LSI-11/2 microcomputers will be upgraded by the addition of hardware and software for data acquisition and for communications to provide access to the Harvey Mudd College central network of VAX computers. In addition, the department will purchase a stepping motor to complete a Fourier transform spectrometer and photon counting accessories. The new equipment will be used in a junior-level optics laboratory, a senior-level advanced laboratory, and in individual student research projects.

Anthony A. Rockwood  
Metropolitan State College  
Denver, CO

CSI 8750929  
\$6,967

#### **"A Spring Thunderstorm Project for Undergraduate Meteorology Students"**

The Spring Thunderstorm Project will allow students to measure the vertical profile of temperature, moisture, pressure, and wind in the immediate vicinity of a thunderstorm using a portable weather balloon system. Metropolitan State College will purchase the balloon system, or sounding sys-

tem, and ground-based data recording equipment with grant funds. Meteorology students will carry the system into the field during the spring thunderstorm season and will release the instrumented balloons into the environments of the storms. The data collected will be used for case studies of the storms and will be the basis for a greater understanding of the storm's structure.

Thunderstorms are one of nature's most important phenomena, yet little is known about their individual formation, detailed structure, or the potentially dangerous weather they may produce. Students involved in this field project will gain valuable experience in observing, instrumentation, and thunderstorm research. The experience they obtain may be applied at a more advanced level of thunderstorm research, where a better understanding of thunderstorms will lead to improved public forecasts and warnings.

Bruce J. Hrivnak  
Valparaiso University  
Valparaiso, IN

CSI 8750722  
\$22,395

#### **"Instrumentation for Astronomical Photoelectric Photometry"**

Valparaiso University will purchase a 16-inch telescope made by DFM Engineering, along with a photoelectric photometer, spectrograph, and microcomputer for data acquisition and reduction. A dome and pier are presently available. The telescope will be used by undergraduate students for viewing and for research projects. Particularly, they will undertake a program of photoelectric photometry of short-period eclipsing binary stars. The students will plan an observing program, obtain measurements of the light variation of the two stars in their orbital cycle, reduce the data to a standard form, and analyze the light curve to obtain orbital and physical properties of the stars. This program will give the students excellent experience in all of the phases of a research project. The results can be presented in scientific meetings and published.

Dennis Barnaal  
Luther College  
Decorah, IA

CSI 8750400  
\$14,390

#### **"Improvement of Microcomputing in the Undergraduate Physics Curriculum"**

The physics department at Luther College will update microcomputer equipment and improve its contribution to physics instruction throughout the physics curriculum. First generation KIM and PET microcomputers were introduced beginning 9 years ago in lower division laboratories and course work. These are now obsolete, and they will

be replaced with PC-XT type computer stations in order to keep students abreast of important current technology and introduce new capabilities in the courses.

The upper division curriculum will be strengthened by purchase of new advanced microcomputers: the PC-AT 16-bit microcomputer, and a 32 bit accelerator board for a Mac-Plus. These will be used to expand instruction in techniques important to the forefront of physics: modeling of complex systems, and the numerical solution of problems by computer. The excellent graphics, very large memory, and high computational speed will permit a new class of problems to be attacked by our students, and also enable new student/faculty research opportunities. In addition, a new telescope mount will be purchased to permit completion of a student-originated research project which involves the computer control of a 14-inch telescope.

Dale W. Olson  
University of Northern Iowa  
Cedar Falls, IA

CSI 8750915  
\$9,799

#### **"Improvement of Undergraduate Optics Laboratory"**

The Physics Department at the University of Northern Iowa will improve experiments in two courses, Holography Laboratory and Lasers and Optics. It will add new experimental capabilities in the areas of holography, lasers and fiber optics. These improvements will also support work by students registering for Undergraduate Research which is required as part of the new Bachelor of Science Program.

New instrumentation to be used includes open-cavity lasers, an electronic driver for a laser spectrum analyzer (previously purchased), a fiber optics lab instruction system, fiber holders, a laser power meter, a fiber cleaver/splicer, a holography table with vibration isolation, and an interferometer useful for characterizing aberrations of lens and holographic optical elements.

Mohamed Ellid  
Wartburg College  
Waverly, IA

CSI 8750536  
\$6,665

#### **"Application of Mossbauer Spectroscopy in Undergraduate Laboratories"**

Mossbauer Spectroscopy allows detailed chemical, structural and magnetic information to be obtained about atoms on the surface of a solid or within its bulk. The Wartburg Physics Department will acquire equipment to allow upper division students to use this valuable technique. It will be used in upper level laboratories for physics majors and in student projects. One of the projects will be aimed at characterizing the active phases of iron and iron-component

catalysts and examining the catalytic properties of these phases. The equipment needed for this project are a multichannel analyzer, velocity transducer, function generator, drive generator, high voltage supply, detector, pre-amplifier, amplifier and single channel analyzer, and radioactive source.

Eric R. Wollman  
Bates College  
Lewiston, ME

CSI 8750084  
\$23,441

#### **"Development of the Laboratory for Non-Majors"**

A simple but sophisticated laboratory equipped with good instruments is an essential component of physical science education for students majoring in the humanities and the social sciences. Bates College will add instruments to the physics and astronomy laboratory for non-majors which will substantially improve the laboratory experience. The instruments consist of telescopes which will collect light for photometers and spectrometers through a fiber-optics system, as well as equipment to measure the properties of photons and electrons. The instruments will allow students to make a wide variety of measurements of the quality of light radiated by laboratory and astronomical sources and to conduct key experiments relevant to the particle-wave nature of light and matter.

Juan Lin  
Washington College  
Chestertown, MD

CSI 8750025  
\$6,767

#### **"Microcomputer and Data Acquisition System for Undergraduate Physics Projects"**

The Physics Department at Washington College will buy a Macintosh, an accelerator board, and a system for data collection in order to do simulations, numerical computation, and data collection and analysis. Students will do projects in the following areas: i) nonlinear dynamics; ii) biological physics; iii) astronomy and astrophysics; and iv) analog-digital interfacing. A dedicated computer system will offer students the possibility to expand their formal work to projects that bring the excitement of current research in physics.

Elizabeth S. Ivey  
Smith College  
Northampton, MA

CSI 8750163  
\$6,397

#### **"Improvement of an Advanced Undergraduate Acoustics Laboratory"**

This project will improve an advanced undergraduate teaching and research laboratory in Acoustics at Smith Col-



lege. The Physics Department will acquire the capability to use holographic interferometry to identify, demonstrate, and analyze the vibrational modes of various objects, starting with musical instruments. For this project Smith will purchase a vibration isolated optical table and base, vibration exciter, accelerometer, digital shutter, variable attenuator/beam splitter, and spatial filter.

The Acoustics course requires a semester-long experimental project from physics majors taking the course, and shorter projects may be elected by non-majors. In addition, the Acoustics laboratory is used by seniors doing Honors and Special Studies projects. Having the capability to use holographic interferometry in the identification of vibrational modes will provide several additional laboratory experiments for the Acoustics course as well as giving majors another technique for use in their experimental projects.

Theodore W. Ducas  
Wellesley College  
Wellesley, MA

CSI 8750777  
\$34,883

#### **"Lasers and Other Instrumentation for Modern Spectroscopic Laboratories in the Undergraduate Physics Curriculum"**

The project entails the coordinated introduction of modern spectroscopy laboratories into the Wellesley physics curriculum. The instrumentation will be used in the sequence of student work that includes the modern physics course, a new advanced laboratory course and student research projects. The requested system includes a nitrogen laser and high resolution dye laser, a boxcar integrator a broadband light source, a spectrometer and lock-in amplifier, detectors and data handling electronics. It is designed to be flexible enough to handle the range of spectroscopic topics that will be covered in the associated courses. The pulsed dye laser will be used to study atomic structure, and the broadband light source will enable students to look at simple quantum structure in solids. In the subsequent advanced course, the lasers, spectrometer and boxcar will be employed for more sophisticated studies of structure and decay in atomic and condensed matter systems and of non-linear effects. Detailed investigations of excitons and the band structure of solids will be made with the spectrometer and lock-in amplifier. This work will correspond closely to the material covered in the Applications of Quantum Mechanics course. Students will then be able to use the same system and the skills they have acquired in their research and honors projects while working with professors who taught them earlier courses. This instrumentation represents a major step in the upgrading of the physics major at Wellesley. The overlap of skills and interest on the part of the participating faculty makes it particularly appropriate and assures continuity in its implementation.

Steven Mellema  
Gustavus Adolphus College  
Saint Peter, MN

CSI 8750140  
\$27,670

#### **"Experimental Modern Physics Laboratory Development Project"**

The Physics Faculty of Gustavus Adolphus College will develop a new junior-level course, Experimental Modern Physics Laboratory. This course will become the capstone laboratory in the sequence of introductory and intermediate classical physics and electronics laboratory courses, required of all majors. The principal goal of the new course is to provide majors with direct experience investigating important microscopic physical phenomena at an advanced undergraduate level using modern instrumentation and data acquisition equipment.

The focus of this project is the implementation of new and modernized experiments in nuclear and condensed matter physics and modern optics. The principal units to be developed are: a gamma-ray spectroscopy facility; an alpha-particle spectroscopy facility; a condensed matter (including low temperature) facility; and a set of modern optics experiments. In addition, four IBM PC-XT computers will be used to control experiments and to collect and analyse data.

Duane N. Olson  
St Olaf College  
Northfield, MN

CSI 8750344  
\$17,469

#### **"Electronic Instruments and Peripherals for a Computerized Physics Laboratory"**

The Physics Department at St. Olaf College is in the process of modernizing its introductory and advanced laboratories. The instrumentation to be acquired will greatly increase access to computers for data acquisition, analysis and display. A variety of instruments, with stand-alone capability as well as computer access, will give access to state-of-the-art electronic devices. These include: a digital multimeter, a digital storage scope, a versatile function generator, and a power supply; all with GPIB capability. The computing equipment will include terminals (with and without graphics capability) to allow greater access to existing multi-user computers, and a PC/AT compatible with high resolution color graphics, plotter, interfacing cards, and software for data acquisition and analysis. The large introductory laboratory sections will benefit from the addition of four microcomputers, with bit-mapped graphics capability, to give access to a routine already developed for data analysis. Two printers will supply hard-copy of the results. A number of electronics and advanced laboratory experiments will take advantage of the greater precision or speed of access to examine topics of fundamental in-

terest, but not generally accessible with conventional instrumentation.

David A. Prescott  
Rutgers University Camden  
Camden, NJ

CSI 8750969  
\$14,535

#### **"Update of the Microprocessor Laboratory Equipment"**

The Physics Department at Rutgers University-Camden will upgrade its present microprocessor laboratory in order to keep the student laboratory work in step with the already updated lecture material and the changes in industrial employment demands. The Department will install fourteen microprocessor developmental study system units. Each unit will consist of a Motorola MEK68000ECB educational computer board, video display, cassette transport, and interconnecting cables. In addition, a network switch, two printers, and cables will be added for hardcopy of student output and system communication. The new equipment will give the student hands on exposure to the latest 16/32 bit CPU architecture. The laboratory exercises will illustrate synchronous and asynchronous data acquisitions and control, 16/32 bit bus architecture, 8/16 bit I/O control, higher level assembly language programming and co-processing techniques with other CPU families. In addition, present laboratory support equipment will afford the opportunity of using higher level system development tools such as Pascal, C, trace analyzers, and process emulators.

John S. Rigden  
American Institute of Physics  
New York, NY

CSI 8751279  
\$122,038  
FY88 \$117,404

#### **"Program to Develop New Approaches to Introductory Physics"**

This project will enable the formation of a committee of physicists who will lead a thorough reexamination of the undergraduate introductory physics course. Over a period of two years the committee will consider issues relating to the introductory course and hold meetings, often in conjunction with major meetings of the American Association of Physics Teachers and the American Physical Society, in order to encourage discussion of the issues in the physics community. It will sponsor two conferences of physicists which will develop a variety of ways to design introductory courses to reflect the needs of students of physics and to reflect the current way physics is done. Through meetings and reports the committee will establish a consensus in the community about what kinds of approaches are valuable, and it will encourage the development and wide distribution of courses based on these approaches.

Rodney L. Varley  
CUNY Hunter College  
New York, NY

CSI 8750582  
\$16,777

#### **"A New Computer Interfaced Undergraduate Physics Laboratory"**

The Department of Physics and Astronomy at Hunter College will introduce a new laboratory for physics majors. Students taking this new laboratory will have had an already existing lecture course and laboratory in the fundamentals of electronics. The equipment purchases will allow physics majors access to microcomputers (personal computers) used to (1) control experiments and (2) collect data from probes placed in the experiment. The five experiments which will be used are in the areas of heat (thermodynamics), properties of magnetic materials, properties of repetitive or oscillatory motion (nonlinear harmonic motion). The students will also see how a computer collects data from an experiment through various kinds of probes which sense the temperature and other quantities in time. The digital computer cannot make continuous measurements of (for example) temperature as it changes with time but instead must measure the temperature at discrete but closely spaced time intervals. This process of digitizing is quite interesting in itself and the student will learn what conditions must be met so that the digitizing is done properly and the result is faithful to the phenomena measured.

The major equipment proposed for purchase are six Macintosh microcomputers, chosen for their ease of use by the student. Also, proposed for purchase are (1) the equipment to perform the experiments, (2) the probes that sense or collect the data from the experiment, and (3) the equipment which connects the signal from the experimental probe to the computer (the computer interface).

John R. Gillespie  
CUNY Herbert L. Lehman College  
New York, NY

CSI 8750657  
\$6,694

#### **"Modernization of Introductory Physics Laboratories Using Computers"**

The Department has undertaken an extensive program of modernization and extension of its entire laboratory program. The major theme of the project is the development of skills related to the acquisition, display, analysis, and interpretation of measured data. Instrumentation and microcomputers typical of modern research and industrial laboratories are being introduced. This project, as the next major step, involves the installation of microcomputers in the mechanics laboratories with direct interfacing to photogates for airtrack experiments. A pilot project last year with one set-up proved very successful. In addition a modern oscilloscope will be introduced for experiments on

sound, AC circuits with reactance, and time-dependent DC circuits. A new experiment will be based on the oscilloscope itself. Now in its sixth year, the modernization program will be completed in another 4 years.

Thomas J. Balonek  
Colgate University  
Hamilton, NY

CSI 8750955  
\$32,297

#### **"High Sensitivity Charged Coupled Device (CCD) Imaging in Undergraduate Astronomy"**

Charged-coupled devices (CCDs) are being increasingly used as sensitive imaging devices on small optical telescopes. The high quantum efficiency and low noise of these array devices permit their use as faint object detectors, so that a small telescope equipped with a CCD camera is operationally equivalent to the largest astronomical telescopes of a decade ago. Colgate University will acquire a high sensitivity cryogenically cooled CCD array imaging system for use with its campus 16-inch telescope to train students in techniques of high accuracy spatial and intensity measurement. Use of the CCD camera system will enable students to work with recent technology such as electronic array detectors, cryogenics, electronics, microcomputers, computer interfacing, computer programming, image analysis, as well as fundamental astronomical research. There are a wide range of astronomical projects which can be conducted by undergraduate students with this instrumentation: imaging of extended or faint objects such as galaxies, nebulae, and star clusters to study their structure and composition; search for the study of transient events such as supernova in distant galaxies, flaring in cataclysmic variable stars and dwarf novae, and motions and changes in appearance of comets and asteroids; monitoring of the optical continuum spectrum and time variability in stars, quasars, and active galaxies. With a device capable of sensing faint astronomical objects, students will become involved in research, using recently developed electronic instrumentation, which is representative of projects being conducted by professional scientists.

Michael J. DeMarco  
SUNY College at Buffalo  
Buffalo, NY

CSI 8750443  
\$16,779

#### **"Videotape-Computer-Assisted Introductory Laboratory for Physics"**

The Physics Department at SUNY College at Buffalo will develop a videotape-computer assisted laboratory in mechanics and wave motion for students in introductory physics. This novel laboratory experience (which involves

videotaping physics laboratory experiments and "real world" experiments that cannot be directly performed in the classroom) will allow the student to gather data and to learn at his or her own rate in an interactive mode. The equipment consists of Macintosh computers, video cameras, and recorders. Students will make detailed measurements on successive video frames using the computer and analyse the motion which has been recorded. It is expected that this project will enable students to better appreciate and learn physics.

Karl C. Mamola  
Appalachian State University  
Boone, NC

CSI 8750796  
\$18,149

#### **"Modern Optics Equipment for Undergraduate Laboratories"**

Appalachian State University will upgrade optics laboratories for undergraduate instruction. A modern optics laboratory will be instrumented for a senior-level course, Optics and Optoelectronics. The laboratory component of this course will include traditional experiments in geometrical and physical optics but will emphasize contemporary topics in optical science such as lasers, fiber optic communication, and holographic techniques. An important part of the laboratory work will be the use, in selected experiments, of microcomputers for data acquisition and instrument control as well as for data analysis. The computer hardware and some of the necessary optics equipment has already been acquired. All of the experiments have been designed and developed and, to the extent possible, tested with the limited equipment on hand.

A number of classical optics experiments currently performed in existing upper-level physics laboratory courses will also be upgraded by supplementing or replacing some older one-of-a-kind apparatus with present generation equipment. Introductory courses for science and pre-engineering majors and others will also be improved by the project.

Geoffrey L. Wilson  
Johnson C Smith University  
Charlotte, NC

CSI 8750823  
\$17,767

#### **"Enhancement of the Laboratory Experience in Introductory Physics Courses through the Use of Computers"**

Physics is both an experimental and a theoretical science, involving an interplay between observed phenomena and their description in mathematical terms. Thus a substantial laboratory experience is an essential component in a proper



study of and understanding of the discipline. Johnson C. Smith University will improve the quality of its undergraduate laboratory instruction in Physics by replacing outmoded equipment with personal computers. These, with appropriate interfacing devices, will be used as measuring instruments to collect data from the students' experiments, and also as tools for analyzing the data and presenting the results. The new laboratory program is expected to increase student interest, and thereby student confidence and competence, and to attract uncommitted students towards a career in the physical sciences and engineering.

Charles A. Bennett, Jr. CSI 8750195  
Univ of North Carolina Asheville \$8,700  
Asheville, NC

#### **"Microcomputers for Introductory and Advanced Undergraduate Physics Laboratories"**

A system of microcomputers will be used to enhance the general physics curriculum at the University of North Carolina, Asheville, and to provide physics majors with experience in data acquisition, analysis and control. A set of four microcomputers equipped with scientific graphics and analysis software will be integrated into the laboratory portion of all introductory physics courses. A fifth microcomputer, equipped with data acquisition hardware and software, will be used to increase the extent to which computer data acquisition and control techniques are used by physics majors in the junior level experimental physics course. The main computer will also be used by students in upper level physics courses as well as senior research projects.

Robert G. Aitken CSI 8750361  
Univ of North Carolina Charlotte \$13,155  
Charlotte, NC

#### **"Upgrade and Computerization of Undergraduate Solid State Laboratories"**

The University of North Carolina at Charlotte is in the process of implementing a microelectronics program. Interdisciplinary and team-taught courses in solid state physics and in semiconductor device physics are being established jointly by the departments of Physics, Electrical Engineering, and Mechanical Engineering and Engineering Science. These lecture courses are being supported by laboratory courses in both subjects, and they are to be required for all engineering students opting for a major in microelectronics. A dedicated computer and data acquisition system will be acquired for the laboratory which supports both of these courses; a programmable lock-in amplifier will also

be used in several of the experiments. These instruments will create a fully modern laboratory where students will gain experience in modern data acquisition techniques, as well as in the principles of solid state physics and of semiconductor device physics.

Louis G. Arnold CSI 8750148  
Otterbein College \$9,525  
Westerville, OH

#### **"Computer Simulation and Computer Data Acquisition in Undergraduate Physics"**

Otterbein College will integrate computer modeling and computational methods into the advanced courses of the physics curriculum and on-line data acquisition and analysis into experimental laboratories. Integration of these techniques with the advanced courses require on-site computer equipment for illustrative demonstrations, computational experiments and problem solving, and the acquisition and analysis of data. The equipment necessary to implement this expansion of the physics curriculum consists of 1) a computer physics work station and associated software; and, 2) an experimental physics laboratory work station with interface devices suitable for the diversity of instruments found in an advanced undergraduate laboratory. The acquaintance with current practices of working physicists provided by the equipment requested will give students a first-hand knowledge of all aspects of computer use as a physics research tool.

Stephen C. Yerian CSI 8750228  
Xavier University \$10,081  
Cincinnati, OH

#### **"Modernization of an X-Ray Physics Laboratory Program for Undergraduates"**

Xavier University will upgrade and update the x-ray physics component of the atomic physics laboratory program taken by physics, applied physics, and physics concentration education majors. By replacing an aging and obsolete x-ray tube power supply with a modern, high-power, highly stabilized and regulated DC high-voltage power supply for the generation of x-rays, significant improvements in x-ray diffraction experiments using cameras and diffractometers will be achieved. By adding a timer and a counter to the data acquisition system and interfacing system to a computer, students will be able to perform experiments using modern digital techniques. The new power supply and new instrumentation will improve the way students perform existing experiments: Bragg diffraction, back-Laue reflection, and diffractometry. In addition it will make possible

new experiments, for example the measurement of x-ray line intensities and intensity ratios and the study of line shapes and fine structure, as well as the computerizing of data acquisition in all experiments. Finally, the new instrumentation will provide a reliable x-ray system for student research projects.

John N. Fox  
Indiana University of Penn.  
Indiana, PA

CSI 8750009  
\$9,147

#### **"Sputtering Facility for Undergraduate Students"**

The Department of Physics at Indiana University of Pennsylvania will purchase a sputtering system and associated equipment which will become a part of a new high vacuum system. The present system, purchased with local funds, contains resistive heating and electron beam evaporators. The addition of the sputtering system will allow students to learn about this important technique and to study properties of amorphous thin films, properties of optical coatings, the preparation of interesting Hall effect films, the fabrication of semiconductor devices, and to use materials which have not been accessible with present techniques.

Robert J. Dukes, Jr.  
College of Charleston  
Charleston, SC

CSI 8616362  
\$70,000  
FY88 \$50,000  
FY89 \$50,000

#### **"A Four College Automatic Photoelectric Telescope for Astronomical Training and Research"**

Many stars vary in brightness, some regularly, some erratically, some in just a few days, some only over many months. The monitoring of these light variations is important for understanding the structure and evolution of the stars. However, it is so time consuming that the stars cannot be monitored at major observatories. Telescopes at colleges generally offer the needed time but do not have good enough weather for quality observations. This grant permits four colleges jointly to purchase a suitable telescope and locate it on Mount Hopkins in Arizona, where the climate is good, observing will be directed by a computer, and the telescope will be serviced along with other similar telescopes. The high-quality observations acquired through this arrangement will be analyzed by students and faculty at the College of Charleston and at The Citadel, both in South Carolina, at Villanova University, Pennsylvania, and at the University of Nevada at Las Vegas, Nevada. The investigators will observe single Sun like stars which vary because of starspots and related activity, chemically peculiar stars, long-period Cepheid variable stars, and hot "emission-line" stars.

In addition, a system of highly accurate brightness standards will be established, both for ease of measuring variable stars and for later use in connection with the European satellite Hipparcos.

The investigators at the four colleges are faculty who have each established their own astronomical research programs. Undergraduate students will be actively involved in the scientific problems.

This project is funded jointly with the Directorate of Mathematical and Physical Sciences.

W. David Driskill  
Belmont College  
Nashville, TN

CSI 8750561  
\$5,500

#### **"Upgrading of an Undergraduate Modern Physics Laboratory"**

Belmont College will improve and enhance the laboratory instruction provided students in a modern physics course. The students enrolled in this course are physics majors and minors, pre-engineering majors, chemistry majors, and mathematics majors. The project will increase the number and level of sophistication of the experiments conducted in this course. Students will be given greater opportunity for "hands-on" experiences with the concepts and phenomena of modern physics.

Equipment items to be purchased include an alpha/beta spectrometer, an X-ray spectrometer, and an electron spin resonance probe. Experiments that explore alpha particle energy spectra, beta particle energies, ESR phenomena, and Zeeman effect studies will be added to the course. Students will have a better understanding and appreciation of the relationship of theory and experiment. The result will be a more balanced presentation of the concepts and phenomena of modern physics.

Rondo N. Jeffery  
Weber State College  
Ogden, UT

CSI 8750830  
\$18,027

#### **"Acquisition of Gamma-ray Spectrometer System for Undergraduate Nuclear Physics Laboratory"**

Significant revisions have recently been made in the curriculum of the senior-level modern physics theory course at Weber State to include Nuclear and Particle Physics as a distinct subject area. A corresponding change in the Modern Physics Laboratory course is planned. The Physics Department will acquire an IBM-PC-based multi-channel analyzer system (MCA), a high resolution HPGe gamma-ray detector, and fast timing detectors, with associated electronics components for this nuclear physics lab. This will

permit a wide range of nuclear experiments to be carried out in this laboratory that are not currently possible with available equipment. In addition to the laboratory course, the equipment will also make possible student research projects in nuclear and solid state physics. The computer-based MCA will give students an opportunity to work with computer-interfaced scientific equipment which is invaluable to their training as physicists.

William Fingerhut  
Lyndon State College  
Lyndonville, VT

CSI 8750236  
\$13,475

#### **"Modernizing an Undergraduate Synoptic Meteorology Laboratory"**

Lyndon State College will acquire modern computer work stations that analyze and display real-time weather data—radiosonde sounding, weather maps, and satellite pictures—for classroom instruction, operational forecasting and student projects. Each work station will consist of an IBM PC/AT personal computer, high resolution EGA color monitor, and appropriate computer upgrades (e.g. memory expansion, color graphics card, etc.), which will be consistent with meteorological data supplied by the University Corporation for Atmospheric Research through its Unidata program. These work stations will familiarize students with modern equipment and greatly improve their three-dimensional perception of atmospheric conditions. They will thus improve undergraduate education in meteorology, as well as weather data dissemination to the local community.

Stephen J. Ratcliff  
Middlebury College  
Middlebury, VT

CSI 8750416  
\$25,632

#### **"A Multi-Telescope Observatory for Undergraduate Astronomy"**

A new astronomical observatory at Middlebury will provide undergraduate students at all levels with an outstanding experience in observational astronomy. A professional quality, computer-controlled 16-inch reflecting telescope will be used to introduce beginning astronomy students to planets, stars, and galaxies. More experienced students will use this telescope for photometry and photography in conjunction with astronomy courses, while undergraduate thesis students will use it for research projects studying variable stars or developing new instrumentation. Three new 8-inch telescopes will be used in lower-level astronomy courses to give students a far greater opportunity for observational work than has previously been possible. The new telescopes and associated instruments will enrich the entire

astronomy curriculum at Middlebury College. In addition, the new observatory will become a community resource through public viewing nights and programs for students in elementary and secondary schools.

Raouf L. Selim  
Christopher Newport College  
Newport News, VA

CSI 8750149  
\$14,675

#### **"A Low Temperature Thermal Measurement System for Undergraduate Students"**

The Department of Physics at Christopher Newport College will establish a laboratory for the measurement of the thermal properties of materials at low temperatures. The aim of the project is twofold. It will provide industrial-quality equipment with which seniors can design the system, giving them critical experience with the principles taught in their digital electronics courses. Furthermore, by using this system, students will investigate experimentally the low temperature phenomena that they have studied in their fundamental courses in thermodynamics, modern physics and solid state. The requested equipment includes a temperature controller, digital meters and current sources, and a diffusion pump. The equipment will be used in conjunction with a closed-cycle helium refrigerator the department already owns. With the automated system students will measure resistivity and specific heat in the temperature range of 10-300 Kelvin.

George F. Spagna, Jr.  
Randolph-Macon College  
Ashland, VA

CSI 8750772  
\$7,536

#### **"Introductory Astronomy Laboratory Upgrade"**

The Randolph-Macon Physics Department will improve the laboratory component of its Introductory Astronomy offering by unifying the experience around a central theme. The purchase of key items of laboratory and observatory equipment will focus the educational task on the range of observing tools and techniques available in modern visible-light astronomy. Experiments in photography, spectroscopy, and photometry will be offered. Each method will be studied in an indoor laboratory setting to provide sufficient skill development prior to applying the techniques in the college observatory. The project will add laboratory spectrometers, a telescope-mounted photometer, and a computer for instrument control to the equipment already available.



Alan S. Thorndike  
University of Puget Sound  
Tacoma, WA

CSI 8750048  
\$6,440

Mary E. Williams-Norton  
Ripon College  
Ripon, WI

CSI 8750024  
\$8,221

### **"An Undergraduate Fluid Phenomena Laboratory"**

The Physics Department at the University of Puget Sound will purchase temperature-control circulators, chart recorders, and a freezer to enable students to perform advanced laboratory experiments and projects in several areas of fluid mechanics. They will carry out experiments in such areas as the physical properties of fluids, the transition to chaos in convecting systems, and the unstable convection which is set up as sea water freezes. In addition to experiments for the upper-division laboratory, the fluids lab will involve two or three students each year in independent study projects which are required for the B.S. in Physics.

John R. Brandenberger  
Lawrence University  
Appleton, WI

CSI 8750076  
\$32,260

### **"Lasers and Modern Optics in Undergraduate Institutions"**

Despite the growing importance of lasers and modern optics, undergraduate institutions rarely provide coursework in these increasingly pivotal areas. At a time when growing numbers of scientists are using lasers in research and when modern optics and microelectronics are spawning new technologies whose impact may rival that of the silicon microchip, undergraduates in this country remain largely on the sidelines.

Lawrence University is undertaking a pilot program designed to determine the staffing and hardware requirements for meaningful instruction in lasers and modern optics in undergraduate institutions. With support from the National Science Foundation and other sources, it will develop courses at several levels, devise suitable laboratory experiments, test various types of lasers and optical hardware, and develop instructional materials. Publications, visits, workshops, and outreach programs will serve to inform other institutions of the details of the findings. The primary objective is to demonstrate to others that undergraduate offerings in laser science and modern optics are feasible and overdue. Aspects of this program are expected to be emulated elsewhere.

The present grant will assist in the acquisition of electronic equipment for use in designing and operating the laser laboratories.

### **"Undergraduate Nuclear Physics Laboratory"**

The Ripon College physics department will renovate its nuclear physics laboratory. A microcomputer and personal-computer-based analyzer will form the core of the new laboratory. Students of modern physics and nuclear physics will learn how to detect ionizing radiation in a variety of new detectors, amplify and shape the electronic signals with modern nuclear electronics modules, collect data under microcomputer control and analyze their results with the microcomputer system. An alpha spectrometer will give the students experience with solid-state detectors and vacuum systems and a new scintillation detector will be used for the detection of gamma rays. As the students use these systems, they will learn about the structure of nuclei, the interactions of ionizing radiation with matter and the many ways a microcomputer can be used as a laboratory instrument.

John H. Karl  
University of Wisconsin Oshkosh  
Oshkosh, WI

CSI 8750800  
\$16,258

### **"A Computer Graphics Workstation for Digital Signal Processing In Undergraduate Physics and Geophysics"**

The University of Wisconsin Oshkosh has integrated an important type of computing called digital signal processing, or DSP into its academic programs. The technique is used to extract information from data in fields such as geophysics, astronomy, meteorology and medicine. Currently DSP is practiced at UW Oshkosh in three different academic programs: physics, computer science and geophysics. Support from the National Science Foundation, matched by UW Oshkosh funds, will be used to purchase a graphics computer workstation, consisting of a Digital Equipment Corporation MicroVax graphics workstation, so that students learning DSP can practice with problems of real-world size and complexity. In addition, data from experiments such as acoustic imaging within the earth, or magnetic resonance data, will be analysed as part of student projects.

Curtiss O. Larson  
Earl Blodgett  
University of Wisconsin River Falls  
River Falls, WI

CSI 8750111  
\$11,960

**"The Incorporation of Fundamentals of Ultrasonic Materials Characterization into the Undergraduate Physics Curriculum"**

Upper division physics majors will have the opportunity to learn the fundamentals of ultrasonic acoustics and ultrasonic characterization of materials. Increasing concern with both product quality and cost has resulted in a demand

for more nondestructive evaluation of materials. Students in two upper division laboratories and in senior seminar projects will use a high resolution, microcomputer controlled mechanical scanner to develop a solid understanding of ultrasonic propagation. In addition to measurement of fundamental acoustic parameters such as group velocity and attenuation, students may examine the frequency dependence of the phase velocity or the spatial distribution of energy in an interrogating ultrasonic beam. Students will learn about ultrasonics and materials in particular, and they also will have the opportunity to do experiments which deal with the fundamental properties of any kind of waves.

## PSYCHOLOGY

Sharon Herzberger  
Trinity College  
Hartford, CT

CSI 8750763  
\$6,265

**"Laboratory Equipment to Improve Undergraduate Instruction in Personality Assessment"**

Psychologists study human beings to understand the causes of behavior and the circumstances under which specific behaviors may be predicted. For their studies psychologists use a variety of assessment techniques, including interviews, observations, and objective and projective testing. The project will establish a research laboratory to enable introductory-level and advanced students to learn about some of the techniques used by psychologists to understand behavior and assess personality. With the establishment of the laboratory, students will be able to participate in research as subjects and to conduct research themselves. This "hands-on" learning experience is expected to enhance student knowledge of personality assessment and correlational and experimental research methodology, as well as to increase their statistical and computer programming skills.

liberal arts university for deaf students one focus of laboratory experimentation and research in the undergraduate experimental psychology course is on the sensory, motor, cognitive and physiological concomitants of deafness. Under the plan students are learning the basic principles of experimental design, data analysis, and preparation of reports by conducting experiments which are both interesting and instructive, utilizing modern and advanced instrumentation. Psychomotor equipment, biofeedback equipment, and operant conditioning equipment have been added as well as a constant illumination projection tachistoscope. In addition to strengthening the undergraduate course in experimental psychology, the equipment is contributing to improvements in other experimentally-oriented courses, such as perception, learning, motivation and independent study (supervised student research).

Robert L. Williams  
Gallaudet University  
Washington, DC

CSI 8750332  
\$15,441

**"An Undergraduate Laboratory Course in Experimental Psychology"**

The scope and quality of undergraduate research in experimental psychology is being expanded and upgraded. The new equipment is allowing laboratory experimentation in four areas: psychomotor performance; biofeedback; operant conditioning; and perception and cognition. As a

Fred L. Yaffe  
Washburn University of Topeka  
Topeka, KS

CSI 8750212  
\$16,142

**"A Computer Laboratory for the Teaching of an Interdisciplinary Course in Psychology and Legal Issues"**

In order to teach scientific principles and methods to non-science oriented majors in an applied area, the project will establish an interdisciplinary course in Psychology and Legal Issues, using a microcomputer laboratory. There has been an increasing use of social scientific reasoning and methodology for understanding legal issues. Many pre-law students receive little if any instruction in the scientific method or any experience conducting research and handling research data, experiences which will ultimately enhance their proficiency as future lawyers. A microcomputer laboratory component containing 20 Apple IIc Micro-sys-

tems will be used in a Psychology and Legal Issues course jointly taught by faculty in the Psychology and Political Science Departments and the School of Law. It will provide an interactive and experiential capability for teaching scientific methods and principles to non-science majors. In addition the microcomputer laboratory will enhance the curricula of both the Psychology and Political Science Departments by being available for use in existing experimental and statistical courses.

Mary M. Brazier  
Loyola University in New Orleans  
New Orleans, LA

CSI 8750403  
\$11,500

#### **"Computerized Laboratories in an Undergraduate Psychology Department"**

The psychology department is upgrading equipment in existing laboratories in learning and perception, in a cognition course, and further promoting and broadening the opportunities for independent student research. The laboratories and research activities supported by this proposal are intended to illustrate the principles and concepts of psychology through first hand exposure, to familiarize students with the scientific methodology and instrumentation in these areas, and ultimately to develop the skills necessary for independent investigation. Six microcomputers, six printers, and two interfacing devices are being requested. Two computers, printers, and the interfaces will be used to support laboratories in learning and three computers and printers will be used in cognition and sensation/perception courses. The sixth computer and printer will be devoted to data analysis and preparation and report writing by students enrolled in the above courses and those carrying out a senior thesis.

John F. Axelson  
College of the Holy Cross  
Worcester, MA

CSI 8750546  
\$26,270

#### **"Modernization of Psychology Natural Science Courses"**

This project will provide contemporary research equipment to enable the psychology department at Holy Cross College to upgrade its natural science education. The Psychology Department has, in its short history, made significant progress in establishing a strong research component to its curriculum. However, its equipment has become antiquated and several courses and laboratories lack adequate scientific and computing equipment necessary to provide modern training. The department is currently revising its curriculum to require students to take a minimum number

of electives falling within the natural science category of Psychology. This grant will provide up-to-date equipment for specific areas of instruction within this category: physiological, sensation and perception, and cognition and memory. Students will have the opportunity to work with modern equipment and program computers to design experiments, collect, and analyze data.

Lyn H. Raible  
Kalamazoo College  
Kalamazoo, MI

CSI 8750179  
\$13,474

#### **"Physiological Psychology Expansion Project"**

The objective of the project is to develop the physiological psychology program at Kalamazoo College to a level that allows students to: (1) have access to a laboratory course in physiological psychology, (2) participate in group research projects, and (3) conduct supervised, but independent research projects. At present, insufficient equipment for animal care and the lack of some basic laboratory equipment have precluded the expansion of the physiological psychology program. The acquisition of cage washing equipment and animal housing will allow the expansion of the animal care facility, thereby increasing the research capacity. The acquisition of equipment necessary for brain surgery (drills, stereotaxis, cryostat, microscope) will greatly expand the surgical techniques that can be used in research and, when combined with the equipment already possessed by the College, will provide students with enormous flexibility in the type of research they can conduct. Increased research capacity and complexity will significantly improve the department's ability to train students in the techniques and theories of physiological psychology and related fields.

Kerry G. Williams  
Winona State University  
Winona, MN

CSI 8750609  
\$17,392

#### **"Psychology Experimental Methods Lab"**

The objective of this project is to increase the quality of laboratory science education in psychology at Winona State University. The focus of the project is on instruction in experimental design and research methods with applications in the areas of learning, cognition and sensation and perception. The equipment requested will provide for a state of the art experimental psychology laboratory. The equipment includes a computer controlled operant conditioning system with eight student lab stations. This equipment will permit students to conduct experiments in a variety of basic learning processes. Also requested are twelve personal computers which will provide the means for con-



ducting a number of experiments in perception, cognition and learning. The equipment will facilitate instruction by giving students first hand experience with a variety of experimental research methods in scientific psychology.

Judith A. McLaughlin  
Eastern Montana College  
Billings, MT

CSI 8750882  
\$13,609

#### **"The Use of Microcomputers to Substitute for and Supplement Traditional Laboratory Equipment in Psychology"**

The Department of Psychology attempts to provide its students with a rigorous, scientifically-based education in Psychology. With the limited resources available to a small school and Montana's current budgetary crisis, providing and maintaining the laboratory equipment necessary for a quality education is becoming increasingly difficult. The project will use computer-simulated laboratory exercises to supplement and substitute for the use of expensive standard laboratory equipment to provide a relatively inexpensive solution to this problem, at the same time providing students with pedagogically-sound laboratory experiences. Microcomputers can combine the functions of numerous pieces of standard laboratory equipment. Software is available and will be written to provide students with experience with a broad range of psychological concepts and experiments.

Harvey Lesser  
Rutgers University Camden  
Camden, NJ

CSI 8750957  
\$23,976

#### **"Observational Laboratory in Developmental Psychology"**

Equipment necessary to start an observational laboratory in developmental psychology and to expand the range of student independent study projects to include observational research, both in the field and in the laboratory has been obtained. Recording equipment, video and audio, and hand-held data collectors for field research are essential for demonstrating current observational research methods for students. An eye-tracker is also an invaluable asset in the developmental laboratory to demonstrate to students an important approach to the study of the development of perceptual and cognitive processes in individuals.

Janet K. Andrews  
Vassar College  
Poughkeepsie, NY

CSI 8750798  
\$14,576

#### **"Enhancement of Laboratory Facilities in Human Perception and Cognition"**

This project will assist the Vassar College psychology department in modernizing and expanding its laboratory

facilities in human perception and cognition. There is a strong need for this enhancement due to curricular expansion and student interest in this growing subarea of psychology, particularly given recent changes in major requirements. Students in psychology, biopsychology, and cognitive science will benefit from the use of computerized stimulus presentation and data collection, graphics, voice synthesis, eye movement tracking, and data loggers through intermediate and laboratory courses in perception and cognition and student independent work in these areas. Available facilities and expertise will allow for optimal use of this equipment to illustrate central methodological techniques in the current study of human perception and cognition through exercises and demonstrations as well as more independent student research. The scientific education of a significant number of undergraduates, particularly women, will be enhanced in the context of a high quality liberal arts institution which has the resources and commitment to support this initiative.

Theodore B. Jaeger  
Methodist College  
Fayetteville, NC

CSI 8750245  
\$9,522

#### **"Developing Scientists in Psychology"**

A year-long Developing Scientist Program for seniors in psychology is enriching the scientific training of talented psychology majors. To implement the program, the college is establishing a psychological laboratory equipped with five Apple IIIGS computers and an interfaceable biofeedback system. Research projects are being carried out in the traditional experimental areas. The students are receiving advanced seminar and one-on-one instruction in hypothesis formulation, design, and execution of experiments, and in data analysis and interpretation. They are each performing one project per semester for two semesters and will prepare experimental reports in journal form describing the projects. The program is enhancing the skill of the students in applying the scientific method to contemporary research problems in psychology, leading ultimately to them making significant contributions to the fields of psychology.

Tracy L. Brown  
Univ of North Carolina Asheville  
Asheville, NC

CSI 8750369  
\$13,746

#### **"Advances in Research Methods Education: Computer Applications in Design, Analysis, and Interfacing"**

The efficient preparation of undergraduate students to benefit from participation in scientific research is a growing

concern at the institution. The project is enhancing undergraduate readiness for participation in research by providing more efficient, comprehensive, and modern instruction in research methods. Using a network system of nine microcomputer lab stations, students are working with instructional programs and statistical software covering the areas of research design, statistics, and computer interfacing. By providing direct statistical analysis, both fundamental and advanced concepts in research methods can be taught more efficiently and thoroughly than is possible in more traditional research programs. In addition, the project is covering the uses of computers in research settings, providing students with both conceptual and practical knowledge relevant to contemporary research methodology. The program should provide a model for other institutions committed to undergraduate research.

Hedy White  
Scott Minor  
Western Carolina University

CSI 8750204  
\$6,717

**"Expanding Experimental Psychology Laboratory: A Three-Field Tachistoscope for Enhancing Undergraduate Research and Courses in Human Information Processing"**

This project is enhancing undergraduate training in experimental psychology. A three-field tachistoscope, with automatic card changers and reaction time apparatus for key-press and voice responses, is being used to expand laboratory assignments and original research projects in areas of human information-processing that have used basic paradigms involving timed presentation of visual stimuli. The project is serving undergraduates, primarily psychology majors (70% of whom are women), enrolled in the following courses: Sensation and Perception; Learning, Memory, and Cognition; Language and Thought; General Research Methods; and Projects (i.e., faculty-supervised independent research). Students will use the tachistoscope in conducting laboratory replications of experiments demonstrating important concepts (e.g., masking in iconic memory, semantic priming) and in conducting original research investigating human information-processing theories. Increasing undergraduate experience in scientific research is intended to encourage graduates to pursue doctoral training in experimental psychology.

Mark Wagner  
Franklin and Marshall College  
Lancaster, PA

CSI 8750413  
\$16,699

**"A Research-Intensive Approach to Undergraduate Education in Psychology"**

This Department is purchasing several pieces of equipment to: (a) support recent curricular changes, (b) replace

antiquated existing equipment and (c) allow majors access to research experiences that are difficult or impossible to obtain with current holdings. There are four basic types of equipment: (1) audio equipment—a 6W speech analysis system and Ensonique sound synthesis system to allow students to modify and analyze human speech, environmental, musical, and animal sounds in a wide variety of course and independent research settings; (2) video equipment—the Gerbrand presentation system and Coreco Image processor to allow students to create, flexibly present, and analyze visual images for the study of human cognition and perception; (3) the Biocomp 2001 to allow students to measure the physiological indices of arousal relevant to both biological psychology and social-personality; (4) artificial intelligence—a Hero 2000 robot and NEXPERT expert system shell to allow students research experience with two of the most burgeoning areas of inquiry in science today—robotics and artificial intelligence. The Department has already had considerable success with its research-oriented approach. The equipment will allow the Department to fully implement this approach.

John D. Batson  
Gilles O. Einstein  
Furman University  
Greenville, SC

CSI 8750875  
\$29,080

**"Psychology Microcomputer Laboratory"**

In recent years, Furman University has outfitted most of its psychology laboratories with appropriate scientific equipment and as a result, psychology students now receive thorough training in most areas of scientific psychology. They do not, however, have access to powerful microcomputers for data capture and data analysis. The chief objective of this project is to equip a multi-purpose laboratory with sophisticated microcomputers so that the psychology department can better prepare undergraduates for research. Psychology students will get an intensive introduction to microcomputers in the second course in the major and will build upon this foundation in upper-level courses.

The computers will be used in three ways. First, and most importantly, students in the course "Experimental and Statistical Methods" will learn to use computers for collecting and analyzing data from experiments they conduct in the course. Second, advanced majors will use the computers for independent research projects that cover a variety of experimental contexts. Finally, a large number of students will utilize the proposed laboratory to conduct computerized exercises (simulations, classic experimental protocols) that demonstrate phenomena that are discussed in many of the upper-level courses and to analyze data that are collected in these courses.

This project will permit the psychology department to complete its goal of equipping the experimental laboratory

courses with high quality scientific instruments. The psychology program will be greatly enhanced, particularly for majors and those students who wish to pursue graduate work in research programs.

Marion T. Gaines, IV  
Presbyterian College  
Clinton, SC

CSI 8750514  
\$7,741

#### **"A Computer-Managed Laboratory for Physiological and Experimental Psychology"**

The purpose of the project is to develop a computer-managed laboratory for physiological and experimental psychology. One such system, developed in the psychology department, permits the precise programming of experimental events, the collection of data, and the analysis and display of results. It has been used to measure reaction times, GSR, EMG, heart rate, temperature and EEG. Because of increasing demands for time with this system, the psychology department plans to construct three more, one with enhanced capabilities for state-of-the-art student research. This enhanced model will be interfaced with a three-field projection tachistoscope and four biopotential preamplifiers for elaborate control of visual events and rapid tracking of evoked EEG activity across the cortex (among other uses). The tachistoscope and amplifiers can be divided to provide for simpler but simultaneous data collection using all the computers. This would be ideal for lab exercises in physiological and experimental psychology. The versatility and precision of this lab system should provide varied possibilities for directed student research, laboratory work in the methodology course, and classroom demonstrations in introductory psychology.

Jerry E. Waters  
Maryville College  
Maryville, TN

CSI 8750121  
\$9,467

#### **"Introduction of Psychobiology into the Curriculum"**

The discipline of psychobiology is being introduced into an interdepartmental advanced level research seminar for psychology and biology majors. Improved physiological measurement experiments are being added to both the laboratory and the research components of the undergraduate psychology and biology curricula. The acquisition of an eight-channel Narcotrace-80 physiograph with the necessary accessories is allowing measurements in sleep physiology and learning, classical conditioning, and biofeedback, as well as heart and muscle physiology. Detailed and accurate physiological measurements are being facilitated with the introduction of psychobiology into the curriculum.

Steve R. Hampton  
Mary Washington College  
Fredericksburg, VA

CSI 8750681  
\$9,365

#### **"Broadening Opportunities for Undergraduate Laboratory Research in Psychology"**

The psychology students will be provided with exposure to a variety of basic scientific laboratory situations involved in the experimental study of behavior. A computerized biofeedback system designed to measure human physiological responses (skin resistance, muscle activity, heart rate and brain waves) is providing students with the opportunity to study experimentally and clinically significant phenomena such as conditioning, emotionality, stress, anxiety and the effects of therapeutic interventions such as biofeedback. Additionally, four custom circuit cards, complete with interface relays and switches, are being used in conjunction with the microcomputers and other hardware. The devices are designed specifically for the psychology laboratory and are facilitating the integration of the microcomputers into the undergraduate laboratory courses. Such integration provides students with first hand experience in using computers to control experiments and record and store data. The equipment is also being used in support of undergraduate student research projects.

Dennis M. Goff  
Randolph-Macon Woman's College  
Lynchburg, VA

CSI 8750734  
\$20,000

#### **"Development of Physiological Psychology and Psychophysiology Laboratory Facilities"**

The purpose of this project is to develop facilities which give undergraduates experience with a range of laboratory procedures that are currently unavailable. This project is part of a more comprehensive adjustment in the psychology department's curriculum which will reestablish an emphasis on laboratory experiences. The laboratory in physiological psychology is providing experience with both traditional methodologies and psychophysiological methodologies. A laboratory course in developmental psychobiology is being added to the curriculum to take advantage of the improved animal facilities. The equipment is being used to upgrade the laboratory in introduction to psychology and is available for senior students to use in their independent projects.

Lucien T. Winegar  
Randolph-Macon College  
Ashland, VA

CSI 8750408  
\$12,564

#### **"Statistical Computing in Undergraduate Psychology"**

The integration of statistical computing into the psychology curriculum is providing substantial improvement



in the quality of instruction in statistics and methodology, and an increase in the quality and quantity of research being conducted by the psychology majors. A microcomputer laboratory is being established for statistical computing to be used predominately in three research courses designed as part of a recent curricular revision. The activities are increasing the student's understanding of science, and are contributing to the preparation of scientists and policy-makers who have a more sophisticated appreciation of the research process.

Peter S. Glick  
Terry L. Rew-Gottfried  
Lawrence University

CSI 8750965  
\$9,650

### **"Improvement of Psychology Laboratory Curriculum"**

A microcomputer network will be purchased to improve the content of laboratory portions of research design and cognitive psychology courses. Specific equipment includes six microcomputers connected in a network, data acquisition hardware (for speech digitization and analysis), and software for demonstration, simulation, and student conducted experimentation in cognitive, social, and perceptual psychology. These instruments will significantly improve these courses by presenting fundamental experimental paradigms and by facilitating active student participation in the design and conduct of research projects. This "hands-on" experience in the laboratory will introduce students to the essential methodologies of psychology and develop their critical skills. In addition, the equipment will be used for demonstration purposes in the areas of perceptual, social, and language psychology.

J. Timothy Petersik  
Ripon College  
Ripon, WI

CSI 8750004  
\$5,814

### **"Psychophysical Laboratories in Spatial Vision"**

The primary goal of this project is to develop laboratories that will give students of psychology, psychobiology, and

related health sciences hands-on experience with state-of-the-art equipment and procedures to understand recent advances in the theoretical and applied use of the "Fourier-analysis" hypothesis of spatial vision.

Under this project a visual-image synthesizer and small computer are requested so that laboratories involving psychophysical testing procedures with sine-wave grating stimuli can be developed. Students will learn to test human contrast sensitivity, to interpret the resulting contrast-sensitivity functions, and observe the effects of manipulating the conditions of testing. A set of demonstrations will be developed for use in non-laboratory oriented classes.

Sharyl B. Peterson  
St Norbert College  
De Pere, WI

CSI 8750737  
\$12,634

### **"Microcomputer Based Psychology Student Research Laboratory"**

The purpose of this project is to develop a microcomputer based psychology student research laboratory. Perhaps the most important research tool of contemporary psychology is the microcomputer, with its ability to present a variety of stimuli, and to collect subjects' responses to them. Thus, an important part of preparation for today's undergraduates must involve providing them with opportunities to learn to use microcomputers, to design, set up, and run psychological research, as well as to collect the data generated thereby, analyze it, and prepare their findings for communication with other scholars. The project is providing such learning experiences for psychology students across a spectrum of courses. Students are being introduced to basic procedures in their introductory courses, and to more advanced procedures in more advanced courses, including courses which specifically focus on principles and methods of research. Funding provided six APPLE microcomputers, peripheral hardware for Networking, and selected software to complement the software library.

## SOCIAL SCIENCE

**Eduardo M. Ochoa**  
California State Univ.—L.A.  
Los Angeles, CA

CSI 8750397  
\$50,000  
Economics

### **"Economics and Statistics Microcomputer Laboratory"**

This project would fund a microcomputer classroom/laboratory dedicated to economics, statistics and quantitative methods, class support and student research. The Economics and Statistics Department currently relies on the campus mainframe computers (Cyber) and standard academic software (Minitab, SPSS) for course projects in business statistics and uses programs written by faculty for pedagogical support in economic theory courses. This environment is not easy for undergraduates to deal with and is not typical of the situation they will work in after graduation. Further, the quantitative and statistical software being developed for business today is designed for the stand alone desk top environment. Micro computers will be significantly more "user friendly" and will permit the faculty to concentrate their instruction on the theory and techniques of the subject matter without having to teach the student how to use the computer.

**Homer D. Garcia**  
Pitzer College  
Claremont, CA

CSI 8750886  
\$37,900  
Social Science

### **"Statistical-Quantitative Methods in the Social Sciences"**

A computer laboratory designed to supplement instruction in the social sciences is being created. The students are being exposed to the statistical and other quantitative data analysis techniques applicable in their major. The students are being given opportunities or hands-on experience in class as well as in independent studies computer-based research experiences. With the use of the Micro Vax II in a networking arrangement as well as SPSSX and BMDP Statistics software the students are expanding their experience in computer-based analysis. The mini-computer is being used in advanced statistics classes as well as with large data sets in political science, economics, and sociology. Since many of the students continue on to graduate school there is a need for increasing the statistical and other quantitative skills as well as the ability to generate such data on the computers.

**Joyce P. Kaufman**  
Whittier College  
Whittier, CA

CSI 8750465  
\$15,008  
Political Science

### **"Computer Simulated Negotiation in a Cross-Cultural Context"**

As social scientists the laboratory is the world and the best approximation and understanding of the ways in which nations operate is through representative experiments such as simulations. Simulation as a technique for teaching and learning is an integral part of the Political Science curriculum. However, the simulations were based on human interaction and simple forms of communication. The project is enabling the college through the addition of computers, printers, modems, and support equipment to become a full participant in the International Negotiation Project, which is a simulation of foreign policy decision making that relies on computer technology for communication between member institutions. The simulation is unique and of special interest because institutions around the world routinely participate and communicate in their native tongue. This helps stress problems of decision making while also addressing issues of cross-cultural communication and problems of translation.

**Joseph R. Mobley, Jr.**  
Chaminade University of Honolulu  
Honolulu, HI

CSI 8750868  
\$5,650  
Social Science

### **"Behavioral Sciences Laboratory Instrumentation"**

A Behavioral Sciences Laboratory is being established specifically dedicated to support of student research projects, including those required in research-related courses as well as those of individual students. The IBM AT computers, related hardware, and SPSS/PC Plus Statistics and Graphics software package are greatly enhancing the level and sophistication of student research projects assigned for all students in the Anthropology, Sociology, and Psychology research sequence. The students are gaining hands-on experience in creating, storing and manipulating their data files. They are doing basic to complex descriptive and inferential analyses and graphic presentations of their data. These research capabilities are greatly enhancing the existing curriculum by providing students with an up-to-date, technologically advanced learning experience in behavioral science research.

Patrick A. McGuire  
Hobart and William Smith Colleges  
Geneva, NY

CSI 8750766  
\$6,523  
Economics

**"Macroeconomic Model Building Workshop with Computer Support for Upper Level Quantitative Economics Courses"**

The project's purpose is to obtain instrumentation to enhance the economics curriculum in the areas of quantitative analysis and macroeconomic modeling. The equipment will provide students the opportunity for "hands on" research experience in upper level departmental courses. The workshop will concentrate on macroeconomic model building with an emphasis on the HOWS II model, an econometric model of the U.S. economy developed in a macro policy workshop over the past few years. The workshop will be located in a specific space on campus and used exclusively by students and faculty involved in upper level economics courses with an emphasis on research oriented and/or model building efforts. The project will support the acquisition of computer equipment for use in the macroeconomic workshop that will continue through the entire academic year and extend through the summer months with a student/faculty research emphasis.

Susan J. Bender  
Skidmore College  
Saratoga Springs, NY

CSI 8750390  
\$9,580  
Anthropology

**"Developing Archaeological Field Methods and Laboratory Analysis in Undergraduate Education and Research"**

This project seeks to expand the scope of archaeological field and laboratory activities through the acquisition of key pieces of equipment. The goal of the proposal is two-fold. The first is to enable students to work more efficiently both in the field (e.g., through magnetometer-based subsurface survey) and in the laboratory (e.g., through the application of a database management system). The second is to expand the range of analysis and data presentation in student research through the use of more sophisticated equipment (e.g., transit mapping, high power microscopy, and photographic recording).

William A. Imperatore  
Appalachian State University  
Boone, NC

CSI 8750863  
\$12,617  
Geography

**"Enhancement of Computer Cartography Instruction and Laboratory"**

The Department of Geography and Planning at Appalachian State University has begun the implementation of a

plan for improved instruction in the area of computer assisted cartography. The equipment requested for this project is needed for the next phase in the evolution of its instructional capabilities in computer mapping technology. Students will work on projects in which they will generate digit files of geographic entities of varying size and scale; produce high quality choropleth and overlay maps of large data bases using commercially available map bases; generate maps at different scales; combine maps of different scales on a single page; change perspectives of computer generated maps; and use geographic information system analysis techniques. Students will also receive experience with a large format digitizing tablet and multi-pen/multi-color plotter which is standard in public and private agencies which employ geographers, planners, draftsmen, designers and other scientists who work with spatial information. This project is responsive both to trends in the discipline and advances in the available technology.

Robin L. Bartlett  
Denison University  
Granville, OH

CSI 8750174  
\$30,173  
Economics

**"Improving Undergraduate Economic Instruction with a Computer Laboratory"**

This project is enhancing the science education of students enrolled in Economics by introducing computer-assisted experiments that supplement traditionally presented materials in such courses as Principles of Economics, Micro and Macroeconomic Theory, and Econometrics. The computers also add great flexibility to the treatment of topics studied in the Senior Seminars. The mix of technologies now available takes advantage of the computational and graphic capabilities of each machine, allows programming flexibility for the future, and fully utilizes the developing computer expertise of the faculty. Economics instruction is greatly improved by bringing the computer into the classroom, thus allowing students to run regressions, to make forecasts, and to simulate policy outcomes with the instructor nearby. Selected software includes Formodel 1000 for both the Macroeconomics and the Money and Banking labs, and SHAZAM for Econometrics. Moreover, this new laboratory approach to teaching Economics makes students intensely aware of integral part that computers and scientific experimentation play in the professional lives of present day economists. With its new suite of computing equipment, the laboratory is able to accommodate sections of up to thirty students.



David G. Blanchard  
University of Wisconsin Oshkosh  
Oshkosh, WI

CSI 8750534  
\$16,995  
Economics

Dennis M. Richter  
University of Wisc.—Whitewater  
Whitewater, WI

CSI 8750740  
\$15,775  
Geography

**"Simulation of the National Economy for  
Macroeconomics Classes"**

This project provides a computer lab for students which will enable them to experience the impact on the national economy of various changes in national policy. The Department of Economics at the University of Wisconsin Oshkosh is extending its strategy of providing computer simulations of economics in its core courses to its macro principles and intermediate macro theory sections. Using a high quality spreadsheet and the fine resolution of the Apple Macintosh computer, student imputed changes impact the simulated economy. The software and department-developed templates provide an easy way for students to record both the numerical impact and graphic illustration of their policy changes.

**"Computer Graphics for Geographic Analysis and  
Problem Solving"**

The purpose of this laboratory instrumentation project is to improve and increase computer usage in statistical analysis and graphics applications in upper division (major and minor program) geography courses. Students will have the opportunity to access large data bases, perform more sophisticated statistical analyses, and produce maps, graphs, and charts in a much less time consuming manner. This will allow more time for material research and report writing, as well as encouraging additional in-depth data analysis and graphic presentation. The proposal will continue the computer applications upgrading begun by the Department in the middle 1970's as part of an ongoing effort at affording geography students the best education possible within the discipline with regard to both personal enrichment and career opportunities.

## II. FY 1987 AWARDS: LOCATION BY STATE AND INSTITUTION

| STATE<br>INSTITUTION<br>CITY, ZIP<br>AWARD TITLE                                                                                                                         | PROJECT DIRECTOR<br>DEPARTMENT                                  | DISCIPLINE<br>CODE | AWARD<br>AMOUNT | GRANT<br>NUMBER | PAGE |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|--------------------|-----------------|-----------------|------|
| <b>Alabama</b>                                                                                                                                                           |                                                                 |                    |                 |                 |      |
| Birmingham Southern Col<br>Birmingham 35254<br>Equipment for a Modern Undergraduate Cell Biology Laboratory                                                              | Leo Pezzementi<br>Biology                                       | BZ                 | \$22,046        | 8750089         | 5    |
| Samford Univ<br>Birmingham 35229<br>Improvement of Undergraduate Instruction in Chemistry through NMR                                                                    | James D. Fisk<br>Chemistry                                      | CH                 | \$26,000        | 8750054         | 24   |
| Univ of South Alabama<br>Mobile 36688<br>Introduction of an Advanced Undergraduate Software Development Station                                                          | Russell M. Hayes, Jr.<br>Electrical Engineering                 | EN                 | \$16,317        | 8750613         | 47   |
| Univ of South Alabama<br>Mobile 36688<br>Unix Based Graphics Work Station Laboratory for Computer Science Students                                                       | William A. Ward, Jr.<br>Div. of Computer & Information Sciences | CS                 | \$50,000        | 8750616         | 41   |
| <b>Arkansas</b>                                                                                                                                                          |                                                                 |                    |                 |                 |      |
| Arkansas College<br>Batesville 72501<br>Infrared Spectrophotometry in Undergraduate Chemistry Instruction                                                                | Bert E. Holmes<br>Chemistry                                     | CH                 | \$25,057        | 8750879         | 24   |
| Arkansas Tech University<br>Russellville 72801<br>An Undergraduate Thermofluids Measurement and Analysis Laboratory.                                                     | Nasser Rashidnia<br>Engineering                                 | EN                 | \$30,656        | 8750103         | 47   |
| Hendrix College<br>Conway 72032<br>High Resolution Gamma Spectroscopy and X-ray Fluorescence for the Advanced Undergraduate Laboratory                                   | Peter J. Pella<br>Physics                                       | PY                 | \$ 7,250        | 8750232         | 64   |
| Hendrix College<br>Conway 72032<br>Acquisition of Infrared Spectrophotometers for Microscale Organic Laboratory                                                          | Thomas E. Goodwin<br>Chemistry                                  | CH                 | \$ 8,589        | 8750417         | 25   |
| U Arkansas Little Rock<br>Little Rock 72204<br>A Modern Undergraduate Engineering Technology Measurement Laboratory.                                                     | Hirak C. Patangia<br>Electronics Engineering Technology         | EN                 | \$50,000        | 8750732         | 47   |
| <b>California</b>                                                                                                                                                        |                                                                 |                    |                 |                 |      |
| Cal St Poly Univ Pomona<br>Pomona 91768<br>Modern Optics and Spectroscopy for Undergraduates                                                                             | Steven W. McCauley                                              | PY                 | \$34,172        | 8750530         | 64   |
| Cal St Univ Fullerton<br>Fullerton 92631<br>Equipment for Neurobiological Experiments and Computerized Data Acquisition/Analysis in an Undergraduate Physiology Program. | Joyce K. Ono<br>Biology                                         | BZ                 | \$43,082        | 8750586         | 5    |

| <i>STATE<br/>INSTITUTION<br/>CITY, ZIP<br/>AWARD TITLE</i>                                                                                                                          | <i>PROJECT DIRECTOR<br/>DEPARTMENT</i>            | <i>DISCIPLINE<br/>CODE</i> | <i>AWARD<br/>AMOUNT</i> | <i>GRANT<br/>NUMBER</i> | <i>PAGE</i> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|----------------------------|-------------------------|-------------------------|-------------|
| Cal St Univ Hayward<br>Hayward 94542<br>Portable Equipment for Teaching Undergraduate Biology Students to Conduct Digital Video Analyses<br>along Environmental Gradients.          | Christopher L. Kitting<br>Biological Sciences     | BZ                         | \$13,422                | 8750588                 | 5           |
| Cal St Univ Long Beach<br>Long Beach 90840<br>Hydrowinch and Automated Probe Sampling System for an Undergraduate Ocean Studies Laboratory<br>Aboard a Six Campus Consortium Vessel | Murray D. Dailey<br>Southern Calif Ocean Studies  | IN                         | \$23,053                | 8750058                 | 58          |
| Cal St Univ Long Beach<br>Long Beach 90840<br>Implementation of Field-Oriented Projects into the Senior Level Undergraduate Geophysics Curriculum                                   | Roswitha B. Grannell<br>Geological Sciences       | EZ                         | \$38,704                | 8750776                 | 44          |
| Cal St Univ Long Beach<br>Long Beach 90840<br>Instrumentation for a Newly Revised Undergraduate Biochemistry Laboratory Course                                                      | Jeffrey A. Cohlberg<br>Chemistry                  | CH                         | \$38,778                | 8750821                 | 25          |
| Cal St Univ Los Angeles<br>Los Angeles 90032<br>An Undergraduate Coastal Hydraulics Laboratory Wave Generating Channel.                                                             | Young C. Kim<br>Civil Engineering                 | EN                         | \$12,880                | 8750146                 | 47          |
| Cal St Univ Los Angeles<br>Los Angeles 90032<br>Gene Manipulation: A Practical Undergraduate Education in the Theory, Methods, and Potential of<br>Biotechnology.                   | Sandra B. Sharp<br>Biology                        | BZ                         | \$49,421                | 8750387                 | 6           |
| Cal St Univ Los Angeles<br>Los Angeles 90032<br>Economics and Statistics Microcomputer Laboratory                                                                                   | Eduardo M. Ochoa<br>Economics & Statistics        | SZ                         | \$50,000                | 8750397                 | 80          |
| Cal State Univ Chico<br>Chico 95929<br>An Undergraduate Optical Electromagnetic Wave Laboratory.                                                                                    | Ralph Gagnon<br>Electrical/Electronic Engineering | EN                         | \$29,950                | 8750147                 | 48          |
| Cal State Univ Chico<br>Chico 95929<br>Liquid Chromatography in Undergraduate Chemistry Instruction                                                                                 | William D. Korte<br>Chemistry                     | CH                         | \$13,515                | 8750218                 | 25          |
| Calif St U San Lu Obispo<br>San Luis Obispo 93407<br>An Undergraduate, Robotics Application, Instructional Workcell.                                                                | Unny Menon<br>Computer Integrated Manufacturing   | EN                         | \$32,080                | 8750022                 | 48          |
| Calif St U San Lu Obispo<br>San Luis Obispo 93407<br>An Undergraduate Thermo-mechanical Test Laboratory.                                                                            | Daniel W. Walsh<br>Metallurgical Engineering      | EN                         | \$50,000                | 8750170                 | 48          |
| Calif St U San Lu Obispo<br>San Luis Obispo 93407<br>Upgrading of Undergraduate Structural (Seismic) Testing Laboratories.                                                          | Satwant S. Rihal<br>Architectural Engineering     | EN                         | \$23,250                | 8750748                 | 48          |
| Harvey Mudd Col<br>Claremont 91711<br>Introduction of Computer-Aided Data Acquisition and Analysis in Advanced Undergraduate Physics<br>Instructional Laboratories                  | Richard C. Haskell<br>Physics                     | PY                         | \$15,873                | 8750246                 | 65          |
| Harvey Mudd Col<br>Claremont 91711<br>Parallel Processing System for Undergraduate Instruction                                                                                      | Michael A. Erlinger<br>Computer Science           | CS                         | \$50,000                | 8750727                 | 41          |



| <i>STATE<br/>INSTITUTION<br/>CITY, ZIP<br/>AWARD TITLE</i>                                                                                                 | <i>PROJECT DIRECTOR<br/>DEPARTMENT</i>                | <i>DISCIPLINE<br/>CODE</i> | <i>AWARD<br/>AMOUNT</i> | <i>GRANT<br/>NUMBER</i> | <i>PAGE</i> |
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| Loyola Marymount U<br>Los Angeles 90045<br>An Undergraduate Materials Science/Metallurgy Laboratory.                                                       | Franklin E. Fisher<br>Mechanical Engineering          | EN                         | \$43,000                | 8750454                 | 49          |
| Mount St Mary's College<br>Los Angeles 90049<br>Updating Instrumentation in the Natural Sciences                                                           | Eleanor D. Siebert<br>Physical Sciences & Mathematics | CH                         | \$17,101                | 8750280                 | 25          |
| Northrop University<br>Los Angeles 90045<br>Creating an Undergraduate Electro-optics Laboratory at Northrop University.                                    | David G. Pelka<br>Electrical Engineering              | EN                         | \$50,000                | 8750242                 | 49          |
| Pitzer Col<br>Claremont 91711<br>Statistical-Quantitative Methods in the Social Sciences                                                                   | Homer D. Garcia<br>Sociology/Chicano Studies          | SZ                         | \$37,900                | 8750888                 | 80          |
| Pomona Col<br>Claremont 91711<br>Laboratory Equipment to Improve Undergraduate Instruction in Physiological Psychology                                     | Richard S. Lewis<br>Psychology                        | PS                         | \$ 6,205                | 8750744                 | 6           |
| San Diego State Univ<br>San Diego 92182<br>Digital Techniques in an Undergraduate Electrical Engineering Laboratory.                                       | David Wright<br>Electrical & Computer Engineering     | EN                         | \$50,000                | 8750415                 | 47          |
| San Diego State Univ<br>San Diego 92182<br>Computer Aided Learning Lab for Undergraduate Computer Science                                                  | Roger E. Whitney<br>Mathematical Sciences             | CS                         | \$18,647                | 8750569                 | 41          |
| San Jose State University<br>San Jose 951920139<br>introduction of Gas Chromatography—Mass Spectrometry (GCMS) into the Undergraduate Chemistry Curriculum | Leon S. Yengoyan<br>Chemistry                         | CH                         | \$29,116                | 8750906                 | 25          |
| Sonoma State University<br>Rohnert Park 94928<br>Development of a Modern Undergraduate Computer Graphics Laboratory                                        | Richard H. Gordon<br>Computer & Information Science   | CS                         | \$17,973                | 8750557                 | 41          |
| Whittier College<br>Whittier 90608<br>Photographic Image Analysis by Undergraduates in the Natural and Social Sciences                                     | Dallas D. Rhodes<br>Geology                           | IN                         | \$14,200                | 8750314                 | 58          |
| Whittier College<br>Whittier 90608<br>Microcomputer-Assisted Laboratory Stations for Undergraduate Physiology Courses.                                     | Alfred W. Hanson<br>Biology                           | BZ                         | \$11,833                | 8750389                 | 6           |
| Whittier College<br>Whittier 90608<br>Computer Simulated Negotiation in a Cross-Cultural Context                                                           | Joyce P. Kaufman<br>Political Science                 | SZ                         | \$15,008                | 8750465                 | 80          |
| <b>Colorado</b>                                                                                                                                            |                                                       |                            |                         |                         |             |
| Colorado College<br>Colorado Springs 80903<br>Integrated Chemometrics Program for the Undergraduate Curriculum                                             | Nathan W. Bower<br>Chemistry                          | CH                         | \$25,830                | 8750040                 | 26          |
| Metropolitan State Col<br>Denver 80204<br>A Spring Thunderstorm Project for Undergraduate Meteorology Students                                             | Anthony A. Rockwood<br>Earth Science                  | EZ                         | \$ 6,967                | 8750929                 | 65          |

| STATE<br>INSTITUTION<br>CITY, ZIP<br>AWARD TITLE                                                                                                                                                       | PROJECT DIRECTOR<br>DEPARTMENT                      | DISCIPLINE<br>CODE | AWARD<br>AMOUNT | GRANT<br>NUMBER | PAGE |
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| Regis College<br>Denver 80221<br>Laboratory Equipment to Initiate an Integrated Junior-year Course in Investigative Biology.                                                                           | John F. Nolte<br>Biology                            | BZ                 | \$50,000        | 8750958         | 6    |
| U Colo at Colo Springs<br>Colorado Springs 80933<br>Image Processing/Analysis System and Remote Sensing Center for Undergraduate Students                                                              | Thomas P. Huber<br>Geography & Environmental        | EZ                 | \$49,474        | 8750041         | 45   |
| Univ of Southern Colorado<br>Pueblo 81001<br>Introduction of Fourier Transform-Infrared Spectroscopy (FT-IR) into the Chemistry Curriculum and Integration with Computer-Controlled Gas Chromatography | Melvin L. Druelinger<br>Chemistry                   | CH                 | \$36,456        | 8750177         | 26   |
| <b>Connecticut</b>                                                                                                                                                                                     |                                                     |                    |                 |                 |      |
| Connecticut College<br>New London 06320<br>Improving Electron Microscopic Study in the Undergraduate Curriculum                                                                                        | Lisa M. Baird<br>Botany                             | BZ                 | \$50,000        | 8750877         | 7    |
| Southern Conn State Col<br>New Haven 06515<br>An Undergraduate Computer Hardware Laboratory.                                                                                                           | Ataollah Elahi<br>Computer Science                  | CS                 | \$31,300        | 8750749         | 41   |
| St Joseph College<br>West Hartford 06117<br>Incorporation of New NMR Applications in the Undergraduate Chemistry Curriculum                                                                            | Harold T. McKone<br>Chemistry                       | CH                 | \$31,585        | 8750142         | 26   |
| Trinity College<br>Hartford 06106<br>Undergraduate Instruction in FT-NMR                                                                                                                               | Richard V. Prigodich<br>Chemistry                   | CH                 | \$50,000        | 8750507         | 26   |
| Trinity College<br>Hartford 06106<br>Laboratory Equipment to Improve Undergraduate Instruction in Personality Assessment.                                                                              | Sharon Herzberger<br>Psychology                     | PS                 | \$ 6,265        | 8750763         | 74   |
| Trinity College<br>Hartford 06106<br>Automating the Undergraduate Engineering Materials Laboratory.                                                                                                    | Roy B. Davis, III<br>Engineering & Computer Science | EN                 | \$11,602        | 8750859         | 49   |
| U S Coast Guard Academy<br>New London 06320<br>An Undergraduate Computer Assisted Scalar Network Analysis Laboratory.                                                                                  | Michael E. McKaughan<br>Engineering                 | EN                 | \$11,000        | 8750498         | 49   |
| University of Bridgeport<br>Bridgeport 06602<br>An Undergraduate Communication Systems Laboratory.                                                                                                     | Gerald T. Volpe<br>Electrical Engineering           | EN                 | \$49,650        | 8750110         | 49   |
| University of Bridgeport<br>Bridgeport 06602<br>An Undergraduate Interdisciplinary Artificial Intelligence Laboratory.                                                                                 | Porter D. Sherman<br>Computer Science               | CS                 | \$50,000        | 8750129         | 41   |
| University of New Haven<br>West Haven 06516<br>Biochemical Equipment for an Undergraduate Forensic Science Laboratory in Blood/Body Fluid Identification and Individualization.                        | R. E. Gaensslen<br>Forensic Science                 | BZ                 | \$15,086        | 8750754         | 7    |

| <i>STATE<br/>INSTITUTION<br/>CITY, ZIP<br/>AWARD TITLE</i>                                                                                            | <i>PROJECT DIRECTOR<br/>DEPARTMENT</i>       | <i>DISCIPLINE<br/>CODE</i> | <i>AWARD<br/>AMOUNT</i> | <i>GRANT<br/>NUMBER</i> | <i>PAGE</i> |
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| <b>District of Columbia</b>                                                                                                                           |                                              |                            |                         |                         |             |
| Gallaudet University<br>Washington 20002<br>An Undergraduate Laboratory Course in Experimental Psychology                                             | Robert L. Williams<br>Psychology             | PS                         | \$15,441                | 8750332                 | 74          |
| Gallaudet University<br>Washington 20002<br>Undergraduate Engineering Technology Program for the Hearing Impaired.                                    | H. David Snyder<br>Physics                   | EN                         | \$36,869                | 8750356                 | 49          |
| Gallaudet University<br>Washington 20002<br>Equipment for Teaching Field, Survey, and Analysis Techniques in Environmental Biology to Undergraduates. | Paul J. Cunningham<br>Biology                | BZ                         | \$24,571                | 8750493                 | 7           |
| <b>Florida</b>                                                                                                                                        |                                              |                            |                         |                         |             |
| Rollins College<br>Winter Park 32789<br>A Liquid Scintillation Counter to Improve Undergraduate Instruction in Cellular and Subcellular Biology.      | Stephen Klemann<br>Biology                   | BZ                         | \$12,700                | 8750272                 | 7           |
| Rollins College<br>Winter Park 32789<br>Fourier Transform Infrared Spectroscopy in the Chemistry Curriculum at Rollins College                        | Brian G. Ramsey<br>Chemistry                 | CH                         | \$20,800                | 8750373                 | 26          |
| Stetson Univ<br>Deland 32720<br>The Upgrade of a DEC Microvax II to an Undergraduate Laboratory Teaching Tool.                                        | David Lawson<br>Mathematics/Computer Science | CS                         | \$21,255                | 8750568                 | 42          |
| Stetson Univ<br>Deland 32720<br>Instrumentation in the Microscale Organic Laboratory                                                                  | Theodore W. Beiler<br>Chemistry              | CH                         | \$ 6,974                | 8750720                 | 27          |
| Univ of West Fla<br>Pensacola 32514<br>The Establishment of an Undergraduate, Real-time, Embedded System Software and Interfacing Laboratory          | Theodore F. Elbert<br>Systems Science        | CS                         | \$47,179                | 8750068                 | 42          |
| Univ of West Fla<br>Pensacola 32514<br>Mass Spectrometry as an Instructional Tool in the Undergraduate Laboratories                                   | Clifford W. Chang<br>Chemistry               | CH                         | \$25,708                | 8750196                 | 27          |
| <b>Georgia</b>                                                                                                                                        |                                              |                            |                         |                         |             |
| Fort Valley State Col<br>Fort Valley 31030<br>Data Acquisition Workstations for the Undergraduate Linear Circuit Laboratory.                          | F. Jalali<br>Electronic Engr Technology      | EN                         | \$18,570                | 8750539                 | 50          |
| Morehouse College<br>Atlanta 30314<br>Multi-Course Instrumentation Laboratory                                                                         | Troy L. Story, Jr.<br>Chemistry              | CH                         | \$45,648                | 8750001                 | 27          |
| Paine College<br>Augusta 30910<br>Computer-Controlled Instrumentation for the Improvement of Introductory Undergraduate Biology Laboratories.         | Marion Furr<br>Biology                       | BZ                         | \$29,604                | 8750881                 | 8           |



| <i>STATE<br/>INSTITUTION<br/>CITY, ZIP<br/>AWARD TITLE</i>                                                                             | <i>PROJECT DIRECTOR<br/>DEPARTMENT</i>       | <i>DISCIPLINE<br/>CODE</i> | <i>AWARD<br/>AMOUNT</i> | <i>GRANT<br/>NUMBER</i> | <i>PAGE</i> |
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| <b>Hawaii</b>                                                                                                                          |                                              |                            |                         |                         |             |
| Chaminade U of Honolulu<br>Honolulu 96816<br>Behavioral Sciences Laboratory Instrumentation                                            | Joseph R. Mobley, Jr.<br>Behavioral Sciences | SZ                         | \$ 5,650                | 8750868                 | 80          |
| Chaminade U of Honolulu<br>Honolulu 96816<br>NMR in Undergraduate Chemistry Curriculum                                                 | Arthur L. Mori<br>Physical Science           | CH                         | \$26,550                | 8750869                 | 28          |
| <b>Illinois</b>                                                                                                                        |                                              |                            |                         |                         |             |
| Columbia Col<br>Chicago 60605<br>Instrumentation for Undergraduate Instruction in Chemistry for Science, Technology and Communications | Zafra M. Lerman<br>Science                   | CH                         | \$20,653                | 8750193                 | 28          |
| Knox College<br>Galesburg 61401<br>Equipment for Undergraduate Biological Chemistry Laboratories for Teaching Gene Expression.         | Billy W. Geer<br>Biology                     | BZ                         | \$14,658                | 8750319                 | 8           |
| Millikin University<br>Decatur 62522<br>Modern Instrumentation for Project-Based Undergraduate Chemistry Laboratories                  | Homer A. Smith, Jr.<br>Chemistry             | CH                         | \$16,489                | 8750853                 | 28          |
| Western Illinois Univ<br>Macomb 61455<br>Development of a Computational Chemistry Laboratory                                           | Janos Szamosi<br>Chemistry                   | CH                         | \$22,268                | 8750029                 | 29          |
| <b>Indiana</b>                                                                                                                         |                                              |                            |                         |                         |             |
| Butler University<br>Indianapolis 46208<br>Acquisition of Phase Contrast and Fluorescence Microscopes for Biology Education.           | Michael S. Maloney<br>Biological Sciences    | BZ                         | \$25,775                | 8750263                 | 8           |
| DePauw University<br>Greencastle 46135<br>Modernizing the Undergraduate Instrumental Analysis Laboratory                               | David T. Harvey<br>Chemistry                 | CH                         | \$21,995                | 8750039                 | 29          |
| Earlham College<br>Richmond 47374<br>Equipment to Expand Undergraduate Instruction in Cellular and Molecular Biology.                  | William H. Harvey<br>Biology                 | BZ                         | \$34,544                | 8750217                 | 8           |
| Earlham College<br>Richmond 47374<br>Undergraduate Instructional Use of a Diode Array UV/VIS Spectrophotometer                         | Gerald R. Bakker<br>Chemistry                | CH                         | \$ 7,800                | 8750543                 | 29          |
| Goshen College<br>Goshen 46526<br>Equipment for Computer Interfacing in Undergraduate Physiology Laboratories.                         | James S. Miller<br>Biology                   | BZ                         | \$16,108                | 8750690                 | 9           |
| Marion College<br>Marion 46953<br>Integration of the Use of an NMR Spectrometer in an Undergraduate Chemistry Program                  | Edward J. Kelly<br>Chemistry                 | CH                         | \$ 9,180                | 8750289                 | 29          |
| Purdue U Ft Wayne<br>Fort Wayne 46805<br>Acquisition of an X-ray Diffractometer for the Undergraduate Geology Curriculum               | Scott F. Argast<br>Earth & Space Sciences    | EZ                         | \$45,175                | 8750250                 | 45          |
| Purdue U Calumet<br>Hammond 46323<br>A Microcomputer Applications Course and Laboratory for All Undergraduate Engineers                | Richard L. Gonzales<br>Engineering           | EN                         | \$47,970                | 8750330                 | 50          |

| STATE<br>INSTITUTION<br>CITY, ZIP<br>AWARD TITLE                                                                                                                                | PROJECT DIRECTOR<br>DEPARTMENT              | DISCIPLINE<br>CODE | AWARD<br>AMOUNT | GRANT<br>NUMRER | PAGE |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------------|-----------------|-----------------|------|
| Rose-Hulman Inst of Tech<br>Terre Haute 47803<br>Introduction of Biotechnology into the Undergraduate Chemical Engineering Curriculum.                                          | Ronald S. Artigue<br>Chemical Engineering   | EN                 | \$ 9,687        | 8750150         | 50   |
| Rose-Hulman Inst of Tech<br>Terre Haute 47803<br>New Instrumentation and Equipment to Extend Instructional Capabilities in Undergraduate Mechanical Engineering at Rose-Hulman. | Leland K. Shirely<br>Mechanical Engineering | EN                 | \$50,000        | 8750480         | 50   |
| Rose-Hulman Inst of Tech<br>Terre Haute 47803<br>Undergraduate Laboratory Instruction in Electrochemistry                                                                       | Frank A. Guthrie<br>Chemistry               | CH                 | \$ 9,300        | 8750501         | 29   |
| St Mary's College<br>Notre Dame 46556<br>Electron Microscopy in the Undergraduate Biology Curriculum                                                                            | David M. Sever<br>Biology                   | BZ                 | \$49,825        | 8750005         | 9    |
| St Mary's College<br>Notre Dame 46556<br>Development of the Undergraduate Biochemistry Laboratory                                                                               | Pamela L. Plouhar<br>Chemistry & Physics    | CH                 | \$27,380        | 8750481         | 30   |
| Taylor University<br>Upland 46989<br>High Performance Liquid Chromatography/Ion Exchange Chromatography at Taylor University                                                    | Stanley L. Burden<br>Chemistry              | CH                 | \$22,195        | 8750172         | 30   |
| Taylor University<br>Upland 46989<br>An Undergraduate Artificial Intelligence Teaching Laboratory.                                                                              | Timothy C. Diller<br>Information Sciences   | CS                 | \$30,476        | 8750513         | 42   |
| Valparaiso Univ<br>Valparaiso 46383<br>A Universal Testing Machine for an Undergraduate Civil Engineering and Materials Engineering Laboratory.                                 | Gerald R. Seeley<br>Civil Engineering       | EN                 | \$27,100        | 8750643         | 50   |
| Valparaiso Univ<br>Valparaiso 46383<br>Instrumentation for Astronomical Photoelectric Photometry                                                                                | Bruce J. Hrivnak<br>Physics                 | PY                 | \$22,395        | 8750722         | 65   |
| <b>Iowa</b>                                                                                                                                                                     |                                             |                    |                 |                 |      |
| Coe College<br>Cedar Rapids 52402<br>Computer Interfaced UV/Visible Spectrophotometry for the Chemistry Undergraduate                                                           | Stanley R. Watkins<br>Chemistry             | CH                 | \$ 9,111        | 8750159         | 28   |
| Cornell Col<br>Mount Vernon 52314<br>Scientific Equipment for Undergraduate Instruction in Animal Physiology and Behavior.                                                      | Ann Blakley<br>Biology & Chemistry          | BZ                 | \$ 7,767        | 8750306         | 9    |
| Grinnell Col<br>Grinnell 50112<br>Fourier Transform Infrared Spectrophotometer System                                                                                           | Richard Biagioni<br>Chemistry               | CH                 | \$23,987        | 8750712         | 28   |
| Grinnell Col<br>Grinnell 50112<br>Using Powerful Computer Software in a Laboratory Environment to Help Undergraduate Students Develop Mathematical Insight                      | Eugene A. Herman<br>Mathematics             | MA                 | \$50,000        | 8750715         | 63   |
| Luther College<br>Decorah 52101<br>Improving Undergraduate Instruction Through Applications of Nuclear Magnetic Resonance Spectrometry.                                         | Carolyn Mottley<br>Chemistry                | CH                 | \$38,000        | 8750016         | 28   |

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| Luther College<br>Decorah 52101<br>Improvement of Microcomputing in the Undergraduate Physics Curriculum                                        | Dennis Barnaal<br>Physics                  | PY                         | \$14,390                | 8750400                 | 65          |
| Univ of Northern Iowa<br>Cedar Falls 50614<br>Improvement of Undergraduate Optics Laboratory                                                    | Dale W. Olson<br>Physics                   | PY                         | \$ 9,799                | 8750915                 | 66          |
| Wartburg College<br>Waverly 50677<br>Application of Mossbauer Spectroscopy in Undergraduate Laboratories                                        | Mohamed Ellid<br>Physics                   | PY                         | \$ 6,665                | 8750536                 | 66          |
| <b>Kansas</b>                                                                                                                                   |                                            |                            |                         |                         |             |
| Bethany College<br>Lindsborg 67456<br>Improvement of Undergraduate Chemistry Curriculum by Addition of an NMR Spectrometer                      | Mike L. Mitchell<br>Chemistry              | CH                         | \$26,350                | 8750702                 | 30          |
| Washburn Univ of Topeka<br>Topeka 66621<br>An Ultracentrifuge and a Spectrophotometer for an Undergraduate Molecular Biology Laboratory.        | Betty J. Cole<br>Biology                   | BZ                         | \$27,607                | 8750077                 | 10          |
| Washburn Univ of Topeka<br>Topeka 66621<br>A Computer Laboratory for the Teaching of an Interdisciplinary Course in Psychology and Legal Issues | Fred L. Yaffe<br>Psychology                | PS                         | \$16,142                | 8750212                 | 74          |
| <b>Kentucky</b>                                                                                                                                 |                                            |                            |                         |                         |             |
| Eastern Kentucky Univ<br>Richmond 40475<br>Update of Equipment Used in Undergraduate Biochemistry Labs                                          | Jeffrey H. Baxter<br>Chemistry             | CH                         | \$32,847                | 8750036                 | 30          |
| Kentucky State University<br>Frankfort 40601<br>Equipment to Improve Undergraduate Instruction in Cellular and Developmental Biology.           | Karan Kaul<br>Biology                      | BZ                         | \$ 7,510                | 8750558                 | 10          |
| Kentucky Wesleyan Col<br>Owensboro 42301<br>Immunology—A New Capstone Course for Undergraduate Biology Majors.                                  | David F. Oetinger<br>Biology               | BZ                         | \$15,143                | 8750098                 | 10          |
| Murray State Univ<br>Murray 42071<br>Integration of Multinuclear Magnetic Resonance Spectroscopy into a Modern Chemistry Laboratory Program     | Arlene R. Courtney<br>Chemistry            | CH                         | \$50,000                | 8750472                 | 30          |
| <b>Louisiana</b>                                                                                                                                |                                            |                            |                         |                         |             |
| Loyola Univ-New Orleans<br>New Orleans 70118<br>Computerized Laboratories in an Undergraduate Psychology Department                             | Mary M. Brazier<br>Psychology              | PS                         | \$11,500                | 8750403                 | 75          |
| Southern U A&M Baton Rouge<br>Baton Rouge 70813<br>An Undergraduate Digital Communications Laboratory Project.                                  | Ibibia K. Dabipi<br>Electrical Engineering | EN                         | \$49,956                | 8750565                 | 51          |
| <b>Maine</b>                                                                                                                                    |                                            |                            |                         |                         |             |
| Bates College<br>Lewiston 04240<br>Gas Chromatograph Mass Spectrometer for Undergraduate Instruction                                            | Thomas J. Wenzel<br>Chemistry              | CH                         | \$27,710                | 8750027                 | 31          |



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| Bates College<br>Lewiston 04240<br>Development of the Laboratory for Non-Majors                                                                                  | Eric R. Wollman<br>Physics & Astronomy      | PY                         | \$23,441                | 8750084                 | 66          |
| Bates College<br>Lewiston 04240<br>Equipment to Teach Microprocessor Analysis of Video and Analog Signals in an Undergraduate Physiology Laboratory.             | Laura G. Malloy<br>Biology                  | BZ                         | \$30,192                | 8750377                 | 10          |
| Bowdoin College<br>Brunswick 04011<br>A Scanning Electron Microscope for Undergraduate Biology Instruction and Student Research.                                 | William L. Steinhart<br>Biology             | BZ                         | \$50,000                | 8750285                 | 11          |
| University of New England<br>Biddeford 04005<br>Experiments in Receiving Water Analysis                                                                          | Peter Sereico<br>Division of Life Science   | IN                         | \$11,911                | 8750719                 | 58          |
| <b>Maryland</b>                                                                                                                                                  |                                             |                            |                         |                         |             |
| Capitol Inst of Tech<br>Laurel 20708<br>An Undergraduate Network and Distributed Processing Laboratory.                                                          | Harry Harrison<br>Computer Engineering Tech | EN                         | \$37,991                | 8750313                 | 51          |
| Goucher College<br>Towson 21204<br>An Atomic Absorption Spectrometer for Undergraduate Environmental Studies in Biology and Chemistry                            | Esther J. Gibbs<br>Chemistry                | IN                         | \$22,107                | 8750765                 | 58          |
| Morgan State University<br>Baltimore 21239<br>Enhancement of an Undergraduate, General Purpose Interface Bus (GPIB) Controlled Electrical Engineering Laboratory | Peter H. Anderson<br>Electrical Engineering | EN                         | \$50,000                | 8750327                 | 51          |
| Univ of Md Eastern Shore<br>Princess Anne 21853<br>Upgrading of an Undergraduate Materials Testing Laboratory.                                                   | Emin Yilmaz<br>Industrial Education & Tech  | EN                         | \$16,425                | 8750325                 | 51          |
| Washington College<br>Chestertown 21620<br>Microcomputer and Data Acquisition System for Undergraduate Physics Projects                                          | Juan Lin<br>Physics                         | PY                         | \$ 6,767                | 8750025                 | 66          |
| Washington College<br>Chestertown 21620<br>A Polarographic Analyzer System for Undergraduate Laboratories and Student Research                                   | James R. Locker<br>Chemistry                | CH                         | \$ 5,235                | 8750059                 | 31          |
| <b>Massachusetts</b>                                                                                                                                             |                                             |                            |                         |                         |             |
| Col of the Holy Cross<br>Worcester 01610<br>Improvement in Advanced Laboratory Using an Instrumental Laboratory Timesharing Concept                              | George A. Vidulich<br>Chemistry             | CH                         | \$50,000                | 8750477                 | 31          |
| Col of the Holy Cross<br>Worcester 01610<br>Modernization of Psychology Natural Science Courses                                                                  | John F. Axelson<br>Psychology               | PS                         | \$26,270                | 8750546                 | 75          |
| Col of the Holy Cross<br>Worcester 01610<br>Equipment to Support Interdisciplinary Research in Anaerobic Bioconversion for Undergraduates.                       | Banadakoppa T. Lingappa<br>Biology          | BZ                         | \$21,064                | 8750960                 | 11          |

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| Five Colleges Inc<br>Amherst 01002<br>A Boat Equipped with Survey, Sampling, and Analysis Equipment for a Five College Undergraduate Marine Sciences Program                            | Paulette M. Peckol<br>Biological Sciences       | IN                 | \$30,115        | 8750160         | 59   |
| Mt Holyoke Col<br>South Hadley 01075<br>Computer Laboratory for Mathematical Experimentation                                                                                            | Robert J. Weaver<br>Mathematics                 | MA                 | \$36,525        | 8750848         | 63   |
| Mt Holyoke Col<br>South Hadley 01075<br>Instrumentation for the Physical Chemistry Laboratory                                                                                           | Abha Sur<br>Chemistry                           | CH                 | \$21,725        | 8750925         | 31   |
| Smith College<br>Northampton 01063<br>Improvement of an Advanced Undergraduate Acoustics Laboratory                                                                                     | Elizabeth S. Ivey<br>Physics                    | PY                 | \$ 6,397        | 8750163         | 66   |
| Southeastern Mass Univ<br>North Dartmouth 02747<br>The Use of a Computer-Interfaced Differential Scanning Calorimeter in the Undergraduate Laboratory: A Class-Project Oriented Program | Chang-Ning Wu<br>Chemistry                      | CH                 | \$14,934        | 8750943         | 31   |
| Wellesley Col<br>Wellesley 02181<br>Lasers and Other Instrumentation for Modern Spectroscopic Laboratories in the Undergraduate Physics Curriculum                                      | Theodore W. Ducas<br>Physics                    | PY                 | \$34,883        | 8750777         | 67   |
| Western New England Col<br>Springfield 01119<br>Computer-Aided Design Hardware and Software for Integration of CAD into the Undergraduate Mechanical Engineering                        | Mohammad Khosrowjerdi<br>Mechanical Engineering | EN                 | \$40,464        | 8750738         | 52   |
| Williams College<br>Williamstown 01267<br>Meteorologic and Hydrologic Instrumentation for Undergraduate Field Work                                                                      | David P. Dethier<br>Geology                     | IN                 | \$27,723        | 8750838         | 59   |
| <b>Michigan</b>                                                                                                                                                                         |                                                 |                    |                 |                 |      |
| Adrian College<br>Adrian 49221<br>Increased Access to High Quality NMR Spectra                                                                                                          | Willard L. Craft<br>Chemistry                   | CH                 | \$29,630        | 8750399         | 31   |
| Adrian College<br>Adrian 49221<br>Computer-Aided Radio Telemetry Equipment for Undergraduate Studies in Animal Behavior and Ecology.                                                    | Craig Weatherby<br>Biology                      | BZ                 | \$ 7,977        | 8750442         | 11   |
| Albion College<br>Albion 49224<br>Instrumentation for an Integrated Undergraduate Laboratory Program                                                                                    | Robert E. Dininny<br>Chemistry                  | CH                 | \$34,435        | 8750716         | 32   |
| Central Mich Univ<br>Mount Pleasant 48859<br>An Undergraduate Laboratory in High Resolution Graphics and Image Processing.                                                              | Hari B. Bidasaria<br>Computer Science           | CS                 | \$37,330        | 8750078         | 42   |
| Central Mich Univ<br>Mount Pleasant 48859<br>Courses and Development of a New Course in Analytical Scanning Electron Microscopy and Image Analysis                                      | David J. Matty<br>Geology & Biology             | IN                 | \$28,750        | 8750320         | 59   |

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| Concordia College<br>Ann Arbor 48105<br>Computerization of Concordia's Introductory Physics/Earth Science Laboratory                                                                  | Theodore P. Aufdemberge<br>Div of Natural Sci & Math  | IN                 | \$ 6,948        | 8750082         | 60   |
| Eastern Michigan Univ<br>Ypsilanti 48197<br>Modernization of the General Chemistry Laboratory by Integration of Computer-Based Experiments                                            | John W. Moore<br>Chemistry                            | CH                 | \$38,464        | 8750324         | 32   |
| Eastern Michigan Univ<br>Ypsilanti 48197<br>Equipment for Undergraduate Instruction in Toxicology                                                                                     | Michael J. Brabec<br>Chemistry                        | CH                 | \$26,490        | 8750458         | 32   |
| GMI Engr & Mgmt Institute<br>Flint 48502<br>Improvement of an Undergraduate Electrical Machines Laboratory.                                                                           | Bhag S. Guru<br>Elect. & Computer Engineering         | EN                 | \$50,000        | 8750931         | 52   |
| GMI Engr & Mgmt Institute<br>Flint 48502<br>An Undergraduate Quantitative Materials Measurement and Assessment Laboratory for the Manufacturing and Systems Engineering Program.      | Charles V. White<br>Mechanical Engineering            | EN                 | \$22,100        | 8750457         | 52   |
| Kalamazoo Col<br>Kalamazoo 49007<br>Physiological Psychology Expansion Project                                                                                                        | Lyn H. Raible<br>Psychology                           | PS                 | \$13,474        | 8750179         | 75   |
| Kalamazoo Col<br>Kalamazoo 49007<br>Computerized Data Acquisition in Undergraduate Animal Physiology Laboratories                                                                     | Paul R. Sotherland<br>Biology                         | BZ                 | \$ 9,846        | 8750850         | 11   |
| Lawrence Inst of Tech<br>Southfield 48075<br>An Undergraduate Electrical Machines Laboratory.                                                                                         | Robert D. Chute<br>Electrical Engineering             | EN                 | \$22,494        | 8750563         | 52   |
| Saginaw Valley State Col<br>University Cent 48710<br>Improving Undergraduate Laboratory Instruction in Chemistry Through the Use of Energy Dispersive X-Ray Fluorescence Spectroscopy | Peter J. Moehs<br>Chemistry                           | CH                 | \$34,500        | 8750521         | 32   |
| Univ of Michigan Dearborn<br>Dearborn 48128<br>An Undergraduate Laboratory for Real Time Computing and Control.                                                                       | Kiumi Akingbehin<br>Electrical & Computer Engineering | EN                 | \$44,586        | 8750293         | 52   |
| Univ of Michigan Dearborn<br>Dearborn 48128<br>Undergraduate Mechanical Engineering Laboratory Improvement.                                                                           | Keshav S. Varde<br>Mechanical Engineering             | EN                 | \$40,012        | 8750321         | 52   |
| <b>Minnesota</b>                                                                                                                                                                      |                                                       |                    |                 |                 |      |
| Bemidji State University<br>Bemidji 56601<br>Computer Assisted Engineering in an Undergraduate Engineering Physics Program.                                                           | Robert C. Pickett<br>Physics                          | EN                 | \$16,310        | 8750197         | 53   |
| Carleton College<br>Northfield 55057<br>An Undergraduate Computer Graphics Laboratory for Mathematics and Computer Science.                                                           | Jack Goldfeather<br>Mathematics                       | CS                 | \$39,430        | 8750099         | 63   |
| Carleton College<br>Northfield 55057<br>Improving Undergraduate Instruction in Chemistry Through the Use of a Gas Chromatograph/Mass Selective Detector System                        | Jerry R. Mohrig<br>Chemistry                          | CH                 | \$33,472        | 8750210         | 33   |



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| Carleton College<br>Northfield 55057<br>Purchase of an X-Ray Diffraction Unit for Undergraduate Geology                                                                                    | Mary Savina<br>Geology                    | EZ                 | \$45,500        | 8750682         | 45   |
| Concordia Col Moorhead<br>Moorhead 56560<br>Undergraduate Laboratory Equipment for Isolating DNA, RNA, Proteins and Lipids.                                                                | James S. Backer<br>Biology                | BZ                 | \$23,255        | 8750632         | 12   |
| Gustavus Adolphus College<br>Saint Peter 56082<br>Instructional Equipment for an Undergraduate Cell Biology Laboratory.                                                                    | William H. Heidcamp<br>Biology            | BZ                 | \$41,011        | 8750085         | 12   |
| Gustavus Adolphus College<br>Saint Peter 56082<br>Experimental Modern Physics Laboratory Development Project                                                                               | Steven Mellema<br>Physics                 | PY                 | \$27,670        | 8750140         | 67   |
| Macalester Col<br>Saint Paul 55105<br>Equipment for an Undergraduate Field Station Laboratory to Provide On-Site Instruction in Terrestrial and Aquatic Ecology.                           | Daniel J. Hornbach<br>Biology             | BZ                 | \$17,773        | 8750483         | 12   |
| Mankato State University<br>Mankato 56001<br>A Gas Chromatograph/Mass Spectrometer for Undergraduate Instruction in an Interdisciplinary Toxicology Program.                               | Steven D. Mercurio<br>Biology             | BZ                 | \$41,628        | 8750844         | 12   |
| Mankato State University<br>Mankato 56001<br>Development of Biochemistry Laboratory Curriculum                                                                                             | Theresa A. Salerno<br>Chemistry & Geology | CH                 | \$22,274        | 8750845         | 33   |
| St Cloud State Univ<br>Saint Cloud 56301<br>Instrumentation to Develop an Analytical Chromatography Laboratory for Undergraduate Biology.                                                  | David K. DeGroote<br>Biological Sciences  | BZ                 | \$24,292        | 8750520         | 13   |
| St Olaf College<br>Northfield 55057<br>Polymer Chemistry in the Physical Chemistry Laboratory Using a Differential Scanning Calorimeter and Gel Permeation Liquid Chromatography Equipment | George L. Hardgrove, Jr.<br>Chemistry     | CH                 | \$29,278        | 8750342         | 33   |
| St Olaf College<br>Northfield 55057<br>Undergraduate Laboratory Equipment for the Teaching of Genetics.                                                                                    | Alice J. Burton<br>Biology                | BZ                 | \$21,670        | 8750343         | 13   |
| St Olaf College<br>Northfield 55057<br>Electronic Instruments and Peripherals for a Computerized Physics Laboratory                                                                        | Duane N. Olson<br>Physics                 | PY                 | \$17,469        | 8750344         | 67   |
| Winona State Univ<br>Winona 55987<br>Psychology Experimental Methods Lab                                                                                                                   | Kerry G. Williams<br>Psychology           | PS                 | \$17,392        | 8750609         | 75   |

#### Mississippi

|                                                                                                                                                      |                                       |    |          |         |    |
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| Delta State University<br>Cleveland 38733<br>Enhancement of General Chemistry through a Microcomputer Laboratory for Tutorial Work and Data Analysis | J. Paul Hollomon<br>Physical Sciences | CH | \$12,580 | 8750608 | 33 |
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| Mississippi College<br>Clinton 39058<br>Modern Gas Chromatography for an Instrument-Oriented Chemistry Program                                     | John W. Legg<br>Chemistry                           | CH                 | \$ 7,076        | 8750248         | 33   |
| <b>Missouri</b>                                                                                                                                    |                                                     |                    |                 |                 |      |
| Southeast Mo State Univ<br>Cape Girardeau 63701<br>Centrifugation Equipment to Enhance Undergraduate Education in Molecular Biology.               | Walt W. Lilly<br>Biology                            | BZ                 | \$23,855        | 8750903         | 13   |
| Southwest Mo State Univ<br>Springfield 65804<br>Strengthening Undergraduate Organic and Analytical Chemistry—NMR                                   | Vernon J. Thielmann<br>Chemistry                    | CH                 | \$50,000        | 8750708         | 33   |
| Southwest Mo State Univ<br>Springfield 65804<br>Improving Undergraduate Cartography Education with Graphics and Data Base Systems                  | William T. Corcoran<br>Geosciences                  | IN                 | \$37,878        | 8750709         | 60   |
| <b>Montana</b>                                                                                                                                     |                                                     |                    |                 |                 |      |
| Eastern Montana Col<br>Billings 59101<br>The Use of Microcomputers to Substitute for and Supplement Traditional Laboratory Equipment in Psychology | Judith A. McLaughlin<br>Psychology                  | PS                 | \$13,609        | 8750882         | 76   |
| Mt Col Mineral Sci & Tech<br>Butte 59701<br>An Undergraduate Rock Fragmentation Laboratory for Mining Geophysical Engineers.                       | Karl E. Burgher<br>Mining & Geophysical Engineering | EN                 | \$14,499        | 8750031         | 53   |
| <b>Nebraska</b>                                                                                                                                    |                                                     |                    |                 |                 |      |
| Col of St Mary<br>Omaha 68124<br>Computerization of the Introductory Physiology Laboratory.                                                        | Jerome J. King<br>Biology                           | BZ                 | \$ 7,193        | 8750201         | 14   |
| <b>New Hampshire</b>                                                                                                                               |                                                     |                    |                 |                 |      |
| Saint Anselm College<br>Manchester 03102<br>The Research Commons Approach to Teaching General Biological Research Processes.                       | Daniel J. Lavoie<br>Biology                         | BZ                 | \$17,632        | 8750891         | 14   |
| <b>New Jersey</b>                                                                                                                                  |                                                     |                    |                 |                 |      |
| Kean College of NJ<br>Union 07083<br>An Integrated Approach to the Teaching of NMR Methods at the Undergraduate Level                              | Dale E. Vitale<br>Chemistry & Physics               | CH                 | \$30,860        | 8750267         | 34   |
| Rutgers University Camden<br>Camden 08102<br>Equipment for Preparing Plastic Histologic Sections for an Undergraduate Light Microscopy Program.    | William J. Bacha, Jr.<br>Biology                    | BZ                 | \$ 6,575        | 8750222         | 14   |
| Rutgers University Camden<br>Camden 08102<br>Observational Laboratory in Developmental Psychology                                                  | Harvey Lesser<br>Psychology                         | PS                 | \$23,976        | 8750957         | 76   |
| Rutgers University Camden<br>Camden 08102<br>Update of the Microprocessor Laboratory Equipment                                                     | David A. Prescott<br>Physics                        | PY                 | \$14,535        | 8750969         | 68   |

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| Trenton State College<br>Trenton 08625<br>An Undergraduate Automated Test and Measurements Laboratory.                                                                   | Alois J. Riederer<br>Electrical Engineering Technology   | EN                 | \$45,683        | 8750950         | 53   |
| <b>New Mexico</b>                                                                                                                                                        |                                                          |                    |                 |                 |      |
| Col of Santa Fe<br>Santa Fe 87501<br>Equipment for Improving Undergraduate Studies in Physiology and Microscopy.                                                         | David W. Johnson<br>Science & Mathematics                | BZ                 | \$12,999        | 8750401         | 14   |
| <b>New York</b>                                                                                                                                                          |                                                          |                    |                 |                 |      |
| Albany Col of Pharmacy<br>Albany 12208<br>Application of NMR Instrumentation in the Undergraduate Pharmacy Curriculum                                                    | Dan R. Bruss<br>Physical Science                         | CH                 | \$31,700        | 8750088         | 34   |
| CUNY H L Lehman College<br>New York 10468<br>Modernization of Introductory Physics Laboratories Using Computers                                                          | John R. Gillespie<br>Physics & Astronomy                 | PY                 | \$ 6,694        | 8750657         | 68   |
| CUNY H L Lehman College<br>New York 10468<br>Improvement of Instrument Based Instruction in Chemistry                                                                    | Reuben L. Baumgarten<br>Chemistry                        | CH                 | \$36,216        | 8750789         | 34   |
| CUNY Hunter College<br>New York 10021<br>A New Computer Interfaced Undergraduate Physics Laboratory                                                                      | Rodney L. Varley<br>Physics & Astronomy                  | PY                 | \$16,777        | 8750582         | 68   |
| CUNY Hunter College<br>New York 10021<br>Equipping an Undergraduate Instructional Laboratory with the Tools of the Molecular Biologist.                                  | Rivka Rudner<br>Biological Sciences                      | BZ                 | \$45,150        | 8750842         | 15   |
| CUNY Hunter College<br>New York 10021<br>Undergraduate Laboratory for Remote Sensing, Digital Image Processing, Automated Cartography and Geographic Information Systems | Alan H. Strahler<br>Geology & Geography                  | EZ                 | \$50,000        | 8750866         | 45   |
| Canisius Col<br>Buffalo 14208<br>Chemical Separations and Microscale Syntheses                                                                                           | Joseph F. Bieron<br>Chemistry                            | CH                 | \$22,291        | 8750139         | 34   |
| Canisius Col<br>Buffalo 14208<br>An Undergraduate Imaging and Operating Systems Laboratory Enhancement.                                                                  | James A. Leone<br>Computer Science                       | CS                 | \$37,890        | 8750291         | 42   |
| Colgate University<br>Hamilton 13346<br>An Undergraduate Parallel Processing Computer Laboratory                                                                         | Christopher H. Nevison<br>Computer Science               | CS                 | \$35,892        | 8750392         | 43   |
| Colgate University<br>Hamilton 13346<br>Physiological Instrumentation for Basic and Advanced Undergraduate Laboratories.                                                 | Nancy L. Pruitt<br>Biology                               | BZ                 | \$40,014        | 8750793         | 15   |
| Colgate University<br>Hamilton 13346<br>Instrumentation for an Undergraduate Recombinant DNA Laboratory.                                                                 | Robert F. Pohlman<br>Div. of Natural Science & Materials | BZ                 | \$50,000        | 8750861         | 15   |
| Colgate University<br>Hamilton 13346<br>High Sensitivity Charged Coupled Device (CCD) Imaging in Undergraduate Astronomy                                                 | Thomas J. Balonek<br>Physics & Astronomy                 | PY                 | \$32,297        | 8750955         | 69   |



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| Hobart & Wm Smith Cols<br>Geneva 14456<br>Macroeconomic Model Building Workshop with Computer Support for Upper Level Quantitative Economics Courses | Patrick A. McGuire<br>Economics                      | SZ                 | \$ 6,523        | 8750766         | 81   |
| Hobart & Wm Smith Cols<br>Geneva 14456<br>Growth Chambers for Use in Laboratory Studies and Undergraduate Research.                                  | Joel T. Kerlan<br>Biology                            | BZ                 | \$14,550        | 8750916         | 15   |
| Iona College<br>New Rochelle 10801<br>NMR Spectroscopy: Course Revision, Interfacing and Dissemination for Undergraduate Instruction                 | Jerome S. Levkov<br>Chemistry                        | CH                 | \$26,546        | 8750953         | 34   |
| Long Island U Brooklyn<br>New York 11201<br>Microcomputer Interfacing and Microelectronics                                                           | Donald W. Rogers<br>Chemistry                        | CH                 | \$ 7,116        | 8750827         | 35   |
| Manhattan College<br>Riverdale 10471<br>Membrane Gas Separation Experiments for an Undergraduate Chemical Engineering Laboratory.                    | C. Stewart Slater<br>Chemical Engineering            | EN                 | \$21,504        | 8750858         | 53   |
| Medaille Col<br>Buffalo 14214<br>Equipping a Microscope Resource Center for Undergraduates.                                                          | Brian R. Shero<br>Science                            | BZ                 | \$24,425        | 8750282         | 16   |
| Rochester Inst of Tech<br>Rochester 14623<br>Development of an Undergraduate Laser Doppler Anemometry Laboratory                                     | Alan H. Nye<br>Mechanical Engineering                | EN                 | \$29,697        | 8750703         | 53   |
| Rochester Inst of Tech<br>Rochester 14623<br>A Workstation Environment for an Undergraduate Computer Graphics Sequence                               | Evelyn P. Rozanski<br>Undergraduate Computer Science | CS                 | \$50,000        | 8750705         | 43   |
| SUNY College at Buffalo<br>Buffalo 14222<br>Improving an Undergraduate Interdisciplinary Aquatic Science Program on Lake Erie and the Niagara River  | James R. Spotila<br>Aquatic Science Program          | IN                 | \$46,872        | 8750426         | 60   |
| SUNY College at Buffalo<br>Buffalo 14222<br>Videotape-Computer-Assisted Introductory Laboratory for Physics                                          | Michael J. DeMarco<br>Physics                        | PY                 | \$16,779        | 8750443         | 69   |
| SUNY College at Buffalo<br>Buffalo 14222<br>Improvement of Undergraduate Advanced Cell Biology and Recombinant DNA Technology Courses.               | Bonnie M. Sampsell<br>Biology                        | BZ                 | \$22,612        | 8750648         | 16   |
| SUNY College at New Paltz<br>New Paltz 12561<br>Upgrading an Interdisciplinary Electron Microscopy Facility for Undergraduates                       | B. L. Redmond<br>Electron Microscopy Facility        | IN                 | \$46,775        | 8750376         | 60   |
| SUNY College at Oneonta<br>Oneonta 13820<br>Plant Growth Chambers for Undergraduate Laboratories                                                     | Currie D. Marr<br>Biology                            | BZ                 | \$11,160        | 8750023         | 16   |
| Siena College<br>Loudonville 12211<br>Computer Graphics Equipment to Enhance Undergraduate Curriculum                                                | Edward M. Crosson<br>Computer Science                | CS                 | \$49,404        | 8750275         | 43   |
| Siena College<br>Loudonville 12211<br>The Development of a Facility for Symbolically-Aided Instruction in Mathematics and Physics.                   | Russell Dubisch<br>Physics                           | MA                 | \$28,610        | 8750276         | 63   |

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| Siena College<br>Loudonville 12211<br>Modern IR and UV/VIS Spectrophotometry in the Undergraduate Chemistry Curriculum                                      | Karen S. Quaak<br>Chemistry                   | CH                 | \$21,890        | 8750540         | 35   |
| Skidmore Col<br>Saratoga Spring 12866<br>Developing Archaeological Field Methods and Laboratory Analysis in Undergraduate Education and Research.           | Susan J. Bender<br>Sociology/Anthropology     | SZ                 | \$ 9,580        | 8750390         | 81   |
| Vassar College<br>Poughkeepsie 12601<br>Enhancement of Laboratory Facilities in Human Perception and Cognition                                              | Janet K. Andrews<br>Psychology                | PS                 | \$14,576        | 8750798         | 76   |
| Webb Inst of Naval Arch<br>Glen Cove 11542<br>Improvement of a Model Towing Tank for an Undergraduate Naval Architecture Laboratory.                        | Lawrence W. Ward                              | EN                 | \$15,726        | 8750485         | 54   |
| <b>North Carolina</b>                                                                                                                                       |                                               |                    |                 |                 |      |
| Appalachian State Univ<br>Boone 2867<br>8Modern Optics Equipment for Undergraduate Laboratories                                                             | Karl C. Mamola<br>Physics & Astronomy         | PY                 | \$18,149        | 8750796         | 69   |
| Appalachian State Univ<br>Boone 28608<br>Gas Chromatography/Mass Spectrometry in an Undergraduate Chemistry Curriculum                                      | Stephen D. Williams<br>Chemistry              | CH                 | \$20,050        | 8750809         | 35   |
| Appalachian State Univ<br>Boo 28608<br>Enhancement of Computer Cartography Instruction and Laboratory                                                       | William A. Imperatore<br>Geography & Planning | SZ                 | \$12,617        | 80863           | 81   |
| Catawba Col<br>Salisbury 28144<br>Modern Cellular and Molecular Biology in the Undergradj1te Curriculum.                                                    | Steven J. Coggin<br>Biology                   | BZ                 | \$30,256        | 8750386         | 16   |
| Davidson Col<br>Davidson 28036<br>Improving Undergraduate Instruction Chemistry Through the Use of a Photodiode Array Ultraviolet-Visible Spectrophotometer | Felix A. Carroll<br>Chemistry                 | CH                 | \$ 9,921        | 8750021         | 35   |
| Johnson C Smith Univ<br>Charlotte 28216<br>Enhancement of the Laboratory Experience in Introductory Physics Coursesenhrough the Use of Computers            | Geoffrey L. Wilson<br>Chemistry & Physics     | PY                 | \$17,767        | 8750823         | 69   |
| Methodist Col<br>Fayetteville 28301<br>Developing Scientists in Psychology                                                                                  | Theodore B. Jaeger<br>Psychology              | PS                 | \$ 9,522        | 8750245         | 76   |
| N C Agric & Tech St Univ<br>Greensboro 27411<br>Enhanced Undergraduate Instruction in Graphics Science                                                      | Sanjiv Sarin<br>Industrial Engineering        | EN                 | gr\$38,660      | 8750634         | 54   |
| U of N C at Charlotte<br>Charlotte 28223<br>Upgrade and Computerization of Undergraduate Solid State Laboratories                                           | Robert G. Aitken<br>Physics                   | PY                 | \$13,155        | 8750361         | 70   |
| U of N C at Charlotte<br>Charlotte 28223<br>Undergraduate Laboratory Enhancement Through Computer Interactive Experimentation                               | G. P. Mohanty<br>Mechanical Engineering       | EN                 | \$41,773        | 8750412         | 54   |

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| Univ of N C at Asheville<br>Asheville 28814<br>Microcomputers for Introductory and Advanced Undergraduate Physics Laboratories                                                                         | Charles A. Bennett, Jr.<br>Physics | PY                 | \$ 8,700        | 8750195         | 70   |
| Univ of N C at Asheville<br>Asheville 28814<br>An Undergraduate VLSI Design Workstation Laboratory                                                                                                     | Wayne Lang<br>Computer Science     | EN                 | \$12,732        | 8750237         | 43   |
| Univ of N C at Asheville<br>Asheville 28814<br>Advances in Research Methods Education: Computer Applications in Design, Analysis, and Interfacing                                                      | Tracy L. Brown<br>Psychology       | PS                 | \$13,746        | 8750369         | 76   |
| Western Carolina Univ<br>Cullowhee 28723<br>Expanding Experimental Psychology Laboratory: A Three-Field Tachistoscope for Enhancing Undergraduate Research and Courses in Human Information Processing | Hedy White<br>Psychology           | PS                 | \$ 6,717        | 8750204         | 77   |

#### North Dakota

|                                                                                                                                                       |                            |    |          |         |    |
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| Jamestown Col<br>Jamestown 58401<br>Undergraduate Biology & Chemistry Equipment for Upgrading Course Laboratories and Student Research Opportunities. | John F. Brauner<br>Biology | BZ | \$47,692 | 8750255 | 16 |
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#### Ohio

|                                                                                                                                     |                                           |    |          |         |    |
|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|----|----------|---------|----|
| Denison Univ<br>Granville 43023<br>The Use of Computer Algebra Systems in Teaching Introductory Calculus                            | Zaven A. Karian<br>Mathematical Sciences  | MA | \$36,000 | 8750137 | 64 |
| Denison Univ<br>Granville 43023<br>Improving Undergraduate Economic Instruction with a Computer Laboratory.                         | Robin L. Bartlett<br>Economics            | SZ | \$30,173 | 8750174 | 81 |
| Denison Univ<br>Granville 43023<br>FTIR Instrumentation for Undergraduate Instruction                                               | William A. Hoffman, Jr.<br>Chemistry      | CH | \$21,150 | 8750741 | 35 |
| Hiram Col<br>Hiram 44234<br>Instrumentation for Undergraduate Studies of Physiology, Endocrinology, Cellular and Molecular Biology. | Dennis J. Taylor<br>Biology               | BZ | \$22,389 | 8750865 | 17 |
| Kenyon Col<br>Gambier 43022<br>Equipment for Teaching in Vitro Plant Tissue and Organ Culture Techniques to Undergraduates.         | Dorothy E. Jegla<br>Biology               | BZ | \$13,683 | 8750368 | 17 |
| Marietta Col<br>Marietta 45750<br>Providing Expert System Development Tools to Undergraduate Students                               | Larrie V. Hutton<br>Computer Science      | CS | \$22,005 | 8750596 | 43 |
| Oberlin Col<br>Oberlin 44074<br>Equipment for an Undergraduate Neurochemistry and Neuropharmacology Laboratory.                     | Dennison A. Smith<br>Neuroscience Program | BZ | \$14,448 | 8750118 | 17 |
| Oberlin Col<br>Oberlin 44074<br>Purchase of a Fourier-Transform Infrared Spectrometer                                               | Norman C. Craig<br>Chemistry              | CH | \$19,300 | 8750723 | 36 |



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| Otterbein Col<br>Westerville 43081<br>Computer Simulation and Computer Data Acquisition in Undergraduate Physics.                                                               | Louis G. Arnold<br>Physics & Astronomy      | PY                         | \$ 9,525                | 8750148                 | 70          |
| Xavier Univ<br>Cincinnati 45207<br>Modernization of an X-Ray Physics Laboratory Program for Undergraduates                                                                      | Stephen C. Yerian<br>Physics                | PY                         | \$10,081                | 8750228                 | 70          |
| <b>Oregon</b>                                                                                                                                                                   |                                             |                            |                         |                         |             |
| Concordia Col<br>Portland 97211<br>Facilitation of Research by Undergraduates in Life Science.                                                                                  | Charles J. Kunert<br>Life Science           | BZ                         | \$ 9,153                | 8750673                 | 17          |
| Linfield Col<br>McMinnville 97128<br>NMR in Undergraduate Instrumentation in Chemistry and Physics                                                                              | Robert G. Wolcott<br>Chemistry              | CH                         | \$26,372                | 8750192                 | 36          |
| Reed Col<br>Portland 97202<br>Acquisition of a FT-IR Instrument, and its Integration into Reed College's Chemistry Curriculum                                                   | John E. Hancock<br>Chemistry                | CH                         | \$30,531                | 8750840                 | 36          |
| Southern Oregon State Col<br>Ashland 97520<br>A Scanning Electron Microscope for Undergraduate Biological Instruction and Independent Research.                                 | Darlene H. Southworth<br>Biology            | BZ                         | \$28,354                | 8750176                 | 18          |
| Univ of Portland<br>Portland 97203<br>An Undergraduate Systems Software Engineering Laboratory.                                                                                 | Michael C. Mulder<br>Electrical Engineering | CS                         | \$50,000                | 8750355                 | 54          |
| Univ of Portland<br>Portland 97203<br>An Undergraduate, Interdisciplinary, Computer-Integrated Manufacturing Laboratory.                                                        | Ming-Shu Hsu<br>Mechanical Engineering      | EN                         | \$50,000                | 8750487                 | 54          |
| <b>Pennsylvania</b>                                                                                                                                                             |                                             |                            |                         |                         |             |
| Albright Col<br>Reading 19604<br>A High Speed Centrifuge to Complete the Development of an Undergraduate Course in Molecular Genetics.                                          | Gerald L. Kreider<br>Biology                | BZ                         | \$ 8,462                | 8750872                 | 18          |
| Bucknell Univ<br>Lewisburg 17837<br>Modernization of the Undergraduate Geotechnical Engineering Laboratory.                                                                     | Jeffrey C. Evans<br>Civil Engineering       | EN                         | \$26,807                | 8750157                 | 55          |
| Bucknell Univ<br>Lewisburg 17837<br>A Laboratory Course at the Interface of Chemistry and Biology                                                                               | Mitchell I. Chernin<br>Biology & Chemistry  | IN                         | \$43,462                | 8750783                 | 60          |
| Bucknell Univ<br>Lewisburg 17837<br>Velocity Measuring Equipment for the Undergraduate Thermo-Fluids Laboratory.                                                                | James N. Zaiser<br>Mechanical Engineering   | EN                         | \$23,630                | 8750917                 | 55          |
| Chestnut Hill Col<br>Philadelphia 19118<br>Quality Laboratory Instruction for the Undergraduate Chemistry/Biochemistry Major in Analytical Techniques and Research Capabilities | Helen M. Burke<br>Chemistry                 | CH                         | \$ 8,784                | 8750633                 | 36          |

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| Franklin & Marshall Col<br>Lancaster 17604<br>A Research-Intensive Approach to Undergraduate Education in Psychology                                                 | Mark Wagner<br>Psychology                                 | PS                         | \$16,699                | 8750413                 | 77          |
| Gannon University<br>Erie 16541<br>Development of an Undergraduate Computer-aided Design and Test Laboratory.                                                        | Samuel L. Hazen<br>Electrical Engineering                 | EN                         | \$46,170                | 8750876                 | 55          |
| Gwynedd-Mercy Col<br>Gwynedd Valley 19437<br>Integration of Biochemical Analysis Techniques into an Undergraduate Biology Curriculum.                                | Felicia Corsaro-Barbieri<br>Natural Science & Mathematics | BZ                         | \$ 7,400                | 8750069                 | 18          |
| Haverford Col<br>Haverford 19041<br>Acquisition of a Transmission Electron Microscope for Undergraduate Instruction and Research                                     | M. Kaye Edwards<br>Biology                                | BZ                         | \$50,000                | 8750418                 | 19          |
| Holy Family Col<br>Philadelphia 19114<br>Improving Undergraduate Instruction in Organic Chemistry Through Proton NMR Spectrometry                                    | M. Bernice Andrelczyk<br>Chemistry                        | CH                         | \$26,500                | 8750597                 | 36          |
| Indiana U of Pennsylvania<br>Indiana 15705<br>Sputtering Facility for Undergraduate Students                                                                         | John N. Fox<br>Physics                                    | PY                         | \$ 9,147                | 8750009                 | 71          |
| Juniata Col<br>Huntingdon 16652<br>Unix C and Graphics Upgrade of the Undergraduate Computer Science Program.                                                        | Dale L. Wampler<br>Mathematics & Computer Science         | CS                         | \$37,930                | 8750290                 | 43          |
| La Salle University<br>Philadelphia 19141<br>Incorporation of Fourier Transformation Methodology into La Salle University's Undergraduate Chemistry Curriculum       | David J. Cichowicz<br>Chemistry                           | CH                         | \$11,500                | 8750760                 | 36          |
| Lafayette Col<br>Easton 18042<br>FT-IR for Upper Division Undergraduate Chemistry Laboratories                                                                       | Dana P. McDermott<br>Chemistry                            | CH                         | \$19,200                | 8750822                 | 36          |
| Lebanon Valley Col<br>Annville 17003<br>The Introduction of a Gas Chromatograph/Mass Spectrometer into the Chemistry Curriculum to Strengthen Laboratory Instruction | Owen A. Moe, Jr.<br>Chemistry                             | CH                         | \$22,890                | 8750577                 | 36          |
| Lebanon Valley Col<br>Annville 17003<br>Ultracentrifuge and Electrophoresis Equipment for Undergraduate Instruction in Genetics, Molecular Biology, and Biochemistry | Sidney Pollack<br>Biology                                 | IN                         | \$26,107                | 8750769                 | 61          |
| Pa St U Behrend College<br>Erie 16563<br>An Ultraviolet-Visible Computing Spectrophotometer for Laboratory Courses and Undergraduate Research                        | Alan J. Jircitano<br>Science Engineering & Technology     | CH                         | \$ 7,431                | 8750396                 | 36          |
| Rosemont Col<br>Rosemont 19010<br>NMR Spectrometry for an Improved Undergraduate Chemistry Program                                                                   | Suzanne P. Varimbi<br>Chemistry                           | CH                         | \$25,850                | 8750834                 | 36          |
| St Joseph's University<br>Philadelphia 19131<br>Integration of Tissue Culture Techniques into the Undergraduate Biology Curriculum.                                  | Paul M. Tefft<br>Biology                                  | BZ                         | \$22,985                | 8750549                 | 19          |

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| Swarthmore Col<br>Swarthmore 19081<br>A Graphics Workstation Laboratory for Upper-Level Undergraduate Engineering Education                                              | Stephen M. Platt<br>Engineering                    | EN                 | \$19,738        | 8750799         | 55   |
| Univ of Pitt Johnstown<br>Johnstown 15904<br>A Computerized Data Acquisition System for an Undergraduate Engineering Technology Strength of Materials Laboratory.        | H. Richard Feller<br>Engineering Technology Di     | EN                 | \$13,598        | 8750050         | 55   |
| Univ of Scranton<br>Scranton 18510<br>An Undergraduate Software Engineering Laboratory                                                                                   | John A. Beidler<br>Math/Computer Science           | CS                 | \$48,660        | 8750630         | 44   |
| W Chester Univ of Penn<br>West Chester 19383<br>Instrumentation to Improve Undergraduate Instruction in Physiology and Cellular Biology.                                 | Jack Waber<br>Biology                              | BZ                 | \$26,600        | 8750434         | 19   |
| Westminster Col<br>New Wilmington 16142<br>Improvement of the Chemistry Advanced Laboratory Program Through the Addition of Differential Scanning Calorimetry            | Percy Warrick, Jr.<br>Chemistry                    | CH                 | \$ 5,300        | 8750678         | 37   |
| Westminster Col<br>New Wilmington 16142<br>The Addition of Laser Techniques to Advanced Laboratories in Physics and Chemistry                                            | G. Samuel Lightner<br>Physics                      | IN                 | \$ 9,786        | 8750952         | 61   |
| Widener Col Penn Campus<br>Chester 19013<br>On-Line Analysis for an Undergraduate Chemical Engineering Laboratory.                                                       | John W. Hoopes, Jr.<br>Chemical Engineering        | EN                 | \$14,425        | 8750339         | 55   |
| Widener Col Penn Campus<br>Chester 19013<br>Open Circuit Low Turbulence Wind Tunnel with Three-Component Sting Balance for an Undergraduate Fluid Dynamics Laboratory    | John E. Molyneux<br>Mechanical & Civil Engineering | EN                 | \$33,700        | 8750611         | 56   |
| <b>Puerto Rico</b>                                                                                                                                                       |                                                    |                    |                 |                 |      |
| Humacao University Col<br>Humacao 00661<br>Upgrading of the Environmental Chemistry Laboratory through the Implementation of Water and Air Quality Surveillance Stations | Sonia L. Vazquez-Garcia<br>Chemistry               | CH                 | \$31,677        | 8750795         | 37   |
| Int-Amer U PR San German<br>San German 00753<br>Field and Laboratory Equipment for an Undergraduate Ecology and Environmental Sciences Program in the Caribbean.         | Hector Quintero<br>Biology                         | BZ                 | \$24,413        | 8750717         | 19   |
| Inter Amer U PR Metro Cam<br>Hato Rey 00919<br>Equipment to Upgrade the Undergraduate Biology Curriculum, with Emphasis on Microbiology.                                 | Freddy R. Medina<br>Biology                        | BZ                 | \$43,244        | 8750497         | 20   |
| <b>Rhode Island</b>                                                                                                                                                      |                                                    |                    |                 |                 |      |
| Rhode Island College<br>Providence 02908<br>Improving Undergraduate Instruction with High Pressure Liquid Chromatography and Atomic Absorption                           | James G. Magyar<br>Physical Science                | CH                 | \$19,481        | 8750620         | 37   |

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| Roger Williams College<br>Bristol 02809<br>Updating the Biology and Chemistry Curriculums with High Performance Liquid Chromatograph                           | Daniel D. Von Riesen<br>Chemistry          | IN                 | \$ 6,400        | 8750134         | 61   |
| <b>South Carolina</b>                                                                                                                                          |                                            |                    |                 |                 |      |
| College of Charleston<br>Charleston 29424<br>A Four College Automatic Photoelectric Telescope for Astronomical Training and Research                           | Robert J. Dukes<br>Physics                 | PY                 | \$70,000        | 8616362         | 71   |
| Erskine Col & Seminary<br>Due West 29639<br>Improved Teaching of Analytical Methods in an Undergraduate Molecular-Cellular Biology Laboratory.                 | George W. Shiflet, Jr.<br>Biology          | BZ                 | \$26,854        | 8750138         | 20   |
| Furman Univ<br>Greenville 29613<br>Introduction of High-Field Nuclear Magnetic Resonance Spectroscopy into the Undergraduate Curriculum                        | Noel Kane-Maguire<br>Chemistry             | CH                 | \$50,000        | 8750209         | 37   |
| Furman Univ<br>Greenville 29613<br>Psychology Microcomputer Laboratory                                                                                         | John D. Batson<br>Psychology               | PS                 | \$29,098        | 8750875         | 77   |
| Presbyterian Col<br>Clinton 29325<br>A Computer-Managed Laboratory for Physiological and Experimental Psychology                                               | Marion T. Gaines, IV<br>Psychology         | PS                 | \$ 7,741        | 8750514         | 78   |
| <b>South Dakota</b>                                                                                                                                            |                                            |                    |                 |                 |      |
| Augustana Col<br>Sioux Falls 57197<br>Equipment to Enhance an Undergraduate Biotechnology Curriculum.                                                          | Oscar H. Will, III<br>Biology              | BZ                 | \$18,417        | 8750043         | 20   |
| <b>Tennessee</b>                                                                                                                                               |                                            |                    |                 |                 |      |
| Austin Peay State Univ<br>Clarksville 37040<br>Integration of a Fourier Transform Infrared Spectrometer into the Chemistry Curriculum                          | Harvey F. Blanck<br>Chemistry              | CH                 | \$18,608        | 8750101         | 37   |
| Belmont Col<br>Nashville 37203<br>Upgrading of an Undergraduate Modern Physics Laboratory                                                                      | W.David Driskill<br>Chemistry & Physics    | PY                 | \$ 5,500        | 8750561         | 71   |
| Christian Brothers Col<br>Memphis 38104<br>Undergraduate Electrical Engineering Student Development Workstations.                                              | Donald Glaser<br>Electrical Engineering    | EN                 | \$50,000        | 8750504         | 56   |
| Maryville Col<br>Maryville 37801<br>Introduction of Psychobiology into the Curriculum                                                                          | Jerry E. Waters<br>Div of Natural Sciences | PS                 | \$ 9,487        | 8750121         | 78   |
| <b>Texas</b>                                                                                                                                                   |                                            |                    |                 |                 |      |
| Incarnate Word Col<br>San Antonio 78209<br>Equipment for Undergraduate Instruction in Biochemistry, Molecular Biology and their Applications in Biotechnology. | Catalina Fresquez<br>Chemistry             | BZ                 | \$11,696        | 8750970         | 20   |



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| Sam Houston State Univ<br>Huntsville 77341<br>Undergraduate Laboratory Equipment for Teaching Molecular Biology and Biotechnology.                                 | Harold F. Foerster<br>Life Sciences             | BZ                         | \$11,587                | 8750770                 | 21          |
| Trinity Univ<br>San Antonio 78284<br>Optical Activity Determinations in Chemistry and Biochemistry                                                                 | Nancy S. Mills<br>Chemistry                     | CH                         | \$14,540                | 8750180                 | 39          |
| Trinity Univ<br>San Antonio 78284<br>Energy-Dispersive X-ray Fluorescence Spectrometry: Undergraduate Applications in Geology and Geochemistry                     | Diane R. Smith<br>Geology                       | EZ                         | \$38,650                | 8750215                 | 46          |
| U of Houston Downtown Col<br>Houston 77002<br>Integration of Microcomputer-based Instruction into Business Statistics Courses                                      | Carol Jones<br>Applied Mathematical Science     | MA                         | \$42,000                | 8750352                 | 64          |
| <b>Utah</b>                                                                                                                                                        |                                                 |                            |                         |                         |             |
| Weber St Col<br>Ogden 84408<br>Upgrading an Undergraduate Engineering Technology Process Instrumentation and Control Laboratory.                                   | G. Reed Marchant<br>Electronic Engineering Tech | EN                         | \$50,000                | 8750603                 | 56          |
| Weber St Col<br>Ogden 84408<br>Acquisition of Gamma-ray Spectrometer System for Undergraduate Nuclear Physics Laboratory                                           | Rondo N. Jeffery<br>Physics                     | PY                         | \$18,027                | 8750830                 | 71          |
| <b>Vermont</b>                                                                                                                                                     |                                                 |                            |                         |                         |             |
| Lyndon St Col<br>Lyndonville 05851<br>Modernizing an Undergraduate Synoptic Meteorology Laboratory                                                                 | William Fingerhut<br>Meteorology                | EZ                         | \$13,475                | 8750236                 | 72          |
| Middlebury Col<br>Middlebury 05753<br>A Multi-Telescope Observatory for Undergraduate Astronomy                                                                    | Stephen J. Ratcliff<br>Physics                  | PY                         | \$24,632                | 8750416                 | 72          |
| Norwich Univ<br>Northfield 05663<br>An Undergraduate Environmental Monitoring Laboratory Data Acquisition System.                                                  | Gregory D. Wight<br>Engineering & Technology    | EN                         | \$ 9,160                | 8750154                 | 56          |
| <b>Virgin Islands</b>                                                                                                                                              |                                                 |                            |                         |                         |             |
| Col of the Virgin Islands<br>Charlotte Amali 00802<br>Computer Graphics Laboratories for Dynamic Modeling and Visualization of Mathematical and Scientific systems | Lynn Rosenthal<br>Science & Mathematics         | IN                         | \$17,409                | 8750928                 | 61          |
| <b>Virginia</b>                                                                                                                                                    |                                                 |                            |                         |                         |             |
| Christopher Newport Col<br>Newport News 23606<br>A Low Temperature Thermal Measurement System for Undergraduate Students                                           | Raouf L. Selim<br>Physics                       | PY                         | \$14,675                | 8750149                 | 72          |
| Hampden-Sydney Col<br>Hampden Sydney 23943<br>Atomic Absorption Spectrometry for a Project-Based Laboratory Program                                                | Herbert J. Sipe, Jr.<br>Chemistry               | CH                         | \$10,550                | 8750395                 | 39          |

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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|----------------------------|-------------------------|-------------------------|-------------|
| Hollins College<br>Hollins College 24020<br>Electrophoretic Equipment for Improving Undergraduate Biology and Chemistry Programs.                                     | Sandra Boatman<br>Biology & Chemistry        | BZ                         | \$ 7,160                | 8750380                 | 21          |
| James Madison Univ<br>Harrisonburg 22807<br>Experimental Nuclear Chemistry in the Undergraduate Curriculum                                                            | Daniel M. Downey<br>Chemistry                | CH                         | \$19,992                | 8750124                 | 39          |
| Mary Washington College<br>Fredericksburg 22401<br>Broadening Opportunities for Undergraduate Laboratory Research in Psychology                                       | Steve R. Hampton<br>Psychology               | PS                         | \$ 9,365                | 8750681                 | 78          |
| Radford University<br>Radford 24142<br>Automated Land Resources Inventory and Analysis System                                                                         | Bernd H. Kuennecke<br>Geography              | EZ                         | \$50,000                | 8750086                 | 46          |
| Radford University<br>Radford 24142<br>Environmental Chambers to Improve the Undergraduate Biology Curriculum.                                                        | Eugene V. Gourley<br>Biology                 | BZ                         | \$25,500                | 8750261                 | 21          |
| Randolph-Macon Col<br>Ashland 23005<br>Statistical Computing in Undergraduate Psychology                                                                              | Lucien T. Winegar<br>Psychology              | PS                         | \$12,564                | 8750408                 | 78          |
| Randolph-Macon Col<br>Ashland 23005<br>Introductory Astronomy Laboratory Upgrade                                                                                      | George F. Spagna, Jr.<br>Physics             | PY                         | \$ 7,536                | 8750772                 | 72          |
| Randolph-Macon Womans Col<br>Lynchburg 24503<br>Development of Physiological Psychology and Psychophysiology Laboratory Facilities                                    | Dennis M. Goff<br>Psychology                 | PS                         | \$20,008                | 8750734                 | 78          |
| Washington and Lee Univ<br>Lexington 24450<br>Nuclear Magnetic Resonance Spectroscopy                                                                                 | Michael A. Pleva<br>Chemistry                | CH                         | \$30,850                | 8750106                 | 39          |
| <b>Washington</b>                                                                                                                                                     |                                              |                            |                         |                         |             |
| Central Washington Univ<br>Ellensburg 98926<br>Undergraduate Instruction in Geographic Information Systems                                                            | William C. Smith<br>Anthropology             | IN                         | \$50,000                | 8750132                 | 46          |
| Eastern Washington Univ<br>Cheney 99004<br>An Upgraded Undergraduate Materials and Mechanical Engineering Laboratory.                                                 | Michael A. Brzoska<br>Technology             | EN                         | \$ 8,052                | 8750650                 | 56          |
| Evergreen State College<br>Olympia 98505<br>Upgrading the Undergraduate Interdisciplinary Science Programs with X-Ray Microanalysis and Scanning Electron Microscopy. | James M. Stroh<br>Earth & Biological Science | IN                         | \$42,996                | 8750411                 | 62          |
| Evergreen State College<br>Olympia 98505<br>Improving the Undergraduate Chemistry Curriculum with a Gas Chromatograph-Mass Spectrometer                               | Frederick D. Tabbutt<br>Chemistry            | CH                         | \$39,887                | 8750598                 | 39          |
| Gonzaga Univ<br>Spokane 99258<br>A Multiple Local Area Network for Undergraduate Engineering Education in Computer-integrated Design and Manufacturing.               | Ferd H. Mitchell<br>Electrical Engineering   | EN                         | \$50,000                | 8750725                 | 57          |

| STATE<br>INSTITUTION<br>CITY, ZIP<br>AWARD TITLE                                                                                            | PROJECT DIRECTOR<br>DEPARTMENT             | DISCIPLINE<br>CODE | AWARD<br>AMOUNT | GRANT<br>NUMBER | PAGE |
|---------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|--------------------|-----------------|-----------------|------|
| Heritage College<br>Toppenish 98948<br>Instrumentation for Undergraduate Biochemistry and Cellular Biology Laboratories.                    | Virginia B. Brown<br>Science & Mathematics | BZ                 | \$16,309        | 8750901         | 21   |
| Seattle Pacific Univ<br>Seattle 98119<br>Undergraduate Instrumentation and Design Computer Workstations.                                    | Edward J. Bauman<br>Electrical Engineering | EN                 | \$44,964        | 8750819         | 57   |
| Seattle Univ<br>Seattle 98122<br>An Undergraduate Very Large Scale Integrated Circuit Design and Test Laboratory.                           | Gary J. Erickson<br>Electrical Engineering | EN                 | \$49,150        | 8750312         | 57   |
| Seattle Univ<br>Seattle 98122<br>Enhancing Undergraduate Laboratory Experiences in Wastewater and Hazardous Waste Treatment.                | Rolf T. Skrinde<br>Civil Engineering       | EN                 | \$ 7,682        | 8750571         | 57   |
| St Martin's College<br>Lacey 98503<br>Improvement in Engineering Education through Computer Aided Design and Drafting                       | Nader Ghafoori<br>Civil Engineering        | EN                 | \$29,632        | 8750674         | 57   |
| Univ of Puget Sound<br>Tacoma 98416<br>Development of an Undergraduate Computer Graphics Laboratory                                         | Carol M. Smith<br>Computer Science         | CS                 | \$31,405        | 8750013         | 44   |
| Univ of Puget Sound<br>Tacoma 98416<br>Integration of a Fourier Transform Infrared Spectrometer into the Chemistry Undergraduate Curriculum | Kenneth Rousslang<br>Chemistry             | CH                 | \$25,500        | 8750047         | 40   |
| Univ of Puget Sound<br>Tacoma 98416<br>An Undergraduate Fluid Phenomena Laboratory                                                          | Alan S. Thorndike<br>Physics               | PY                 | \$ 6,440        | 8750048         | 73   |
| Univ of Puget Sound<br>Tacoma 98416<br>Equipment to Quantify Undergraduate Course Work and Independent Studies in Animal Behavior.          | Terrence R. Mace<br>Biology                | BZ                 | \$18,471        | 8750166         | 22   |
| Univ of Puget Sound<br>Tacoma 98416<br>An X-ray Microanalysis System for Undergraduate Geology                                              | J. Stewart Lowther<br>Geology              | EZ                 | \$34,682        | 8750167         | 46   |
| Univ of Puget Sound<br>Tacoma 98416<br>Multidisciplinary X-ray Laboratory                                                                   | Keith O. Berry<br>Chemistry                | IN                 | \$50,000        | 8750284         | 62   |
| Western Washington Univ<br>Bellingham 98225<br>Improvement of an Undergraduate Laboratory Curriculum in Molecular/Cellular Biology.         | Hubertus E. Kohn<br>Biology                | BZ                 | \$21,457        | 8750902         | 22   |
| <b>West Virginia</b>                                                                                                                        |                                            |                    |                 |                 |      |
| Marshall Univ<br>Huntington 25701<br>Instrumentation for a Core Undergraduate Course Laboratory in Cellular Biology.                        | Alan R. White<br>Biological Sciences       | BZ                 | \$42,460        | 8750488         | 21   |
| <b>Wisconsin</b>                                                                                                                            |                                            |                    |                 |                 |      |
| Edgewood Col<br>Madison 53711<br>Atomic Absorption Spectroscopy to Enhance the Undergraduate Laboratory Science Curriculum                  | Philip K. Welty<br>Physical Science        | CH                 | \$ 8,985        | 8750475         | 40   |

| STATE<br>INSTITUTION<br>CITY, ZIP<br>AWARD TITLE                                                                                                | PROJECT DIRECTOR<br>DEPARTMENT               | DISCIPLINE<br>CODE | AWARD<br>AMOUNT | GRANT<br>NUMBER | PAGE |
|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|--------------------|-----------------|-----------------|------|
| Edgewood Col<br>Madison 53711<br>Environmentally Controlled Chambers to Improve Project Experiences in Biology for Non-Majors.                  | James Lorman<br>Biology                      | BZ                 | \$ 5,577        | 8750548         | 22   |
| Lawrence Univ<br>Appleton 54912<br>Lasers and Modern Optics in Undergraduate Institutions                                                       | John R. Brandenberger<br>Physics             | PY                 | \$32,260        | 8750076         | 73   |
| Lawrence Univ<br>Appleton 54912<br>Equipment to Improve the Light Microscopy Program in Undergraduate Biology Laboratories.                     | William J. Perreault<br>Biology              | BZ                 | \$12,573        | 8750525         | 23   |
| Lawrence Univ<br>Appleton 54912<br>Improvement of Psychology Laboratory Curriculum.                                                             | Peter S. Glick<br>Psychology                 | PS                 | \$ 9,650        | 8750965         | 79   |
| Ripon Col<br>Ripon 54971<br>Psychophysical Laboratories in Spatial Vision                                                                       | J. Timothy Petersik<br>Psychology            | PS                 | \$ 5,814        | 8750004         | 79   |
| Ripon Col<br>Ripon 54971<br>Undergraduate Nuclear Physics Laboratory                                                                            | Mary E. Williams-Norton<br>Physics           | PY                 | \$ 8,221        | 8750024         | 73   |
| St Norbert Col<br>De Pere 54115<br>Equipment to Support Undergraduate Instruction in Riverine Ecology.                                          | James R. Hodgson<br>Biology                  | BZ                 | \$ 8,105        | 8750735         | 23   |
| St Norbert Col<br>De Pere 54115<br>Microcomputer Based Psychology Student Research Laboratory                                                   | Sharyl B. Peterson<br>Psychology             | PS                 | \$12,634        | 8750737         | 79   |
| St Norbert Col<br>De Pere 54115<br>Nuclear Magnetic Resonance Spectroscopy in Undergraduate Chemistry Instruction                               | David L. Klopotek<br>Chemistry               | CH                 | \$30,400        | 8750790         | 40   |
| Univ of Wis Eau Claire<br>Eau Claire 54701<br>Multidisciplinary Use of an Atomic Absorption Spectrometer in Undergraduate Chemistry and Geology | Robert J. Eierman<br>Chemistry & Physics     | IN                 | \$12,807        | 8750810         | 62   |
| Univ of Wis La Crosse<br>La Crosse 54601<br>Incorporation of Modern Molecular Techniques into the Undergraduate Microbiology Curriculum.        | Michael R. Winfrey<br>Biology & Microbiology | BZ                 | \$47,310        | 8750784         | 23   |
| Univ of Wis La Crosse<br>La Crosse 54601<br>An Undergraduate Computer Aided Software Engineering Laboratory.                                    | David D. Riley<br>Computer Science           | CS                 | \$50,000        | 8750820         | 44   |
| Univ of Wis Oshkosh<br>Oshkosh 54901<br>Fourier Transform Infrared Spectroscopy in the Undergraduate Chemistry Laboratory Curriculum            | Timothy F. Crimmins<br>Chemistry             | CH                 | \$22,250        | 8750071         | 40   |
| Univ of Wis Oshkosh<br>Oshkosh 54901<br>Simulation of the National Economy for Macroeconomics Classes                                           | David G. Blanchard<br>Economics              | SZ                 | \$16,995        | 8750534         | 82   |
| Univ of Wis Oshkosh<br>Oshkosh 54901<br>Undergraduate Laboratory Instrumentation for Biotechnology.                                             | Robert L. Williams<br>Biology & Microbiology | BZ                 | \$11,774        | 8750560         | 23   |



| <i>STATE</i><br><i>INSTITUTION</i><br><i>CITY, ZIP</i><br><i>AWARD TITLE</i>                                                                                         | <i>PROJECT DIRECTOR</i><br><i>DEPARTMENT</i> | <i>DISCIPLINE</i><br><i>CODE</i> | <i>AWARD</i><br><i>AMOUNT</i> | <i>GRANT</i><br><i>NUMBER</i> | <i>PAGE</i> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|----------------------------------|-------------------------------|-------------------------------|-------------|
| Univ of Wis Oshkosh<br>Oshkosh 54901<br>A Computer Graphics Workstation for Digital Signal Processing In Undergraduate Physics and Geophysics                        | John H. Karl<br>Physics                      | PY                               | \$16,258                      | 8750800                       | 73          |
| Univ of Wis Parkside<br>Kenosha 53141<br>Acquisition of X-ray Powder Diffraction Facilities and Upgrading of the Undergraduate X-Ray Scattering Laboratory.          | Peter A. Nielsen<br>Geology                  | IN                               | \$34,687                      | 8750162                       | 62          |
| Univ of Wis River Falls<br>River Falls 54022<br>The Incorporation of Fundamentals of Ultrasonic Materials Characterization into the Undergraduate Physics Curriculum | Curtiss O. Larson<br>Physics                 | PY                               | \$11,960                      | 8750111                       | 73          |
| Univ of Wis Whitewater<br>Whitewater 53190<br>Computer Graphics for Geographic Analysis and Problem Solving                                                          | Dennis M. Richter<br>Geography               | SZ                               | \$15,775                      | 8750740                       | 82          |
| Univ of Wis Whitewater<br>Whitewater 53190<br>Equipment to Facilitate Undergraduate Laboratory Investigations in Cellular Biology.                                   | John J. Ruffolo<br>Biology                   | BZ                               | \$28,551                      | 8750803                       | 24          |

### III. PROJECT DESCRIPTIONS: FY 1988 AWARDS

Indicated for each project are the project director's name, an institution, the grant number and the dollar amount of the NSF award.

#### BIOLOGY

Richard D. Holland  
Livingston University  
Livingston, AL

USE 8851894  
\$15,000  
Biology

##### **"Equipment for Improving Undergraduate Laboratories in Cellular Biology"**

The acquisition of state-of-the-art instrumentation for undergraduate laboratories in Cell Biology is correcting this department's deficiencies in areas of functional biology. The acquisition of a dismembrator, a centrifuge and a refrigerated circulator allow for the isolation of cellular organelles; the electrophoresis unit and spectrophotometer—the characterization of organic compounds; the clean bench, shaker, incubator and chromatography refrigerator—the isolation and maintenance of cell cultures.

The new equipment and instrumentation are making it possible to place needed emphasis on modern biotechnology and functional biology. Improved laboratories in Cell Biology are increasing student success in these courses and enhancing their readiness for professional pursuits.

The grantee institution is matching the NSF award with a more-than-equal sum obtained from non-Federal sources.

James A. Collier  
Mohave Community College  
Kingman, AZ

USE 8853142  
\$11,165  
Biology

##### **"Undergraduate Biology and Chemistry Instrumentation for Freshman and Sophomore Laboratories"**

The goal of this project is to modernize and improve freshman and sophomore biology and chemistry laboratories on the three campuses of a remote two-year college that enrolls large numbers of Native Americans, many of whom are female. The new equipment being incorporated into the teaching program includes plant growth chambers, marine aquaria and computer-interfaced physiology instrumentation. The environmental chambers enhance the school's ability to conduct General Biology laboratory experiments involving plant competition and animal metabolism. The salt-water aquaria are used to expose General

Biology students (most of whom are completely unfamiliar with the ocean) to marine invertebrates. The computer-interfaced physiology instrumentation vastly improves second-year students' opportunities to collect data that quantify the adaptive responses of animals to varying stimuli.

The importance of this instrumentation is that its use in undergraduate laboratory instruction provides more effective teaching of scientific methods for understanding the environment. A practical grasp of how scientific methods are used by investigators is important for both science and non-science majors, and environmental topics hold a special interest for this audience.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Maurice G. Kleve  
University of Arkansas  
Little Rock, AR

USE 8851981  
\$43,384  
Biology

##### **"Image Analysis and Microscopy for Undergraduate Biology"**

This project improves the cell and molecular biology curriculum by providing equipment to (1) develop a hands-on, instrument-based course in Microscopy; (2) improve the quality and effectiveness of laboratories in existing courses in Cell Biology, Developmental Biology, Immunology, and Biological Methods and Instrumentation; and (3) add current technology in microscopy to the available options in the department's undergraduate research program.

The equipment includes three high quality light microscopes equipped with optics and accessories designed for multiple applications of brightfield, phase, polarizing and epi-fluorescence, and a state-of-the-art image processing and analysis system. These new microscopes (along with two existing transmission and x-ray analytical scanning electron microscopes) will be interfaced by film and video with the image processor. The integrated imaging system will be applied in "bench-type" laboratory courses to real experimental situations. This instrument-intensive approach allows students to gain the experience required to operate modern equipment and the critical thinking and

appreciation required to design modern experiments. It is expected to produce graduates who are better equipped for and more likely to undertake post-graduate studies.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Raul J. Cano  
California Poly St Univ  
San Luis Obispo, CA

USE 8851335  
\$48,850  
Biology

#### **"Laboratory Equipment for an Undergraduate Biotechnology Program"**

The equipment obtained through this project is enabling this institution to provide an appropriate theoretical and practical background for students enrolling in a Biotechnology minor that addresses both the need for entry-level technicians in the growing field of biotechnology and the preparation of undergraduates who will go on to pursue advanced academic degrees.

The new minor includes three laboratory courses (Molecular Biology Laboratory, Tissue Culture Techniques, and Protein Laboratory Techniques) that are designed to give each student substantial amounts of "hands-on" experience in basic and specialized techniques in these areas. Grant funds are being used to purchase essential equipment of three types: (a) small equipment needed to equip four student stations (four students/station); (b) several intensive-use items such as HPLCs and laminar flow hoods; and (c) specialty equipment that will introduce undergraduates to "state-of-the-art" technology (e.g., a DNA synthesizer). Such equipment is providing for a smooth sequence of offerings, ranging from "special topic" experiences for only a few students to the complete courses with labs that are essential to creating a well defined curriculum.

This biotechnology program is regarded as having good potential for becoming a national model that can be replicated in other institutions.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Norman H. Pillsbury  
California Poly St Univ  
San Luis Obispo, CA

USE 8851523  
\$50,000  
Biology

#### **"An Integrated Natural Resources Management, Data Acquisition Analysis and Presentation System for Undergraduate Teaching"**

This project is designed to provide Natural Resources Management students with a sequential program of computerized data collection, monitoring, analysis and presentation of synthesized resource and climatic information.

Implementation of this program dramatically improves the Natural Resources Management curriculum by providing state-of-the-art computer equipment, and the opportunity for "hands-on" application of resource management principles with "real-time" analysis and interpretation.

Equipment being purchased through this project include geographic information system hardware (including a digitizer, a color terminal, and plotter), hand-held data logger computers, micro-computer workstations, and a computer projection system for classroom demonstration. This project is vital to the Natural Resources Management curriculum as it provides the opportunity for undergraduates to be exposed and to develop a working understanding of today's technology as currently used by professionals in both industry and government agencies.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Glenn M. Nagel  
California State University  
Fullerton, CA

USE 8853024  
\$15,738  
Biology

#### **"Modern Electrophoresis and Immunochemistry Equipment for Undergraduate Laboratories"**

This project is providing electrophoretic and immunochemistry equipment for use by undergraduate students enrolled in the Biochemistry and Molecular Biology courses. The equipment is being used to educate students in both the theory and the practice of modern techniques used to separate and analyze proteins and nucleic acids from biological sources. The new instrumentation includes a video densitometer, an ELISA reader, eight electrophoresis setups, computer interfaces and software.

A sound set of educational and scientific goals is being pursued systematically under this project. The approach being employed stresses the quantitative uses of electrophoretic and immunochemical methods for detecting molecules (using modern densitometry and absorbance measurements), along with more traditional approaches. Under the resulting program students now are receiving the hands-on laboratory experience necessary to prepare them for scientific careers in biotechnology, the health professions, industry, and research.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

David W. Becker  
Pomona College  
Claremont, CA

USE 8852604  
\$36,471  
Biology

#### **"Equipment for a Modern Undergraduate Laboratory in Plant Biology"**

This project is providing modern laboratory equipment to establish a contemporary cell and molecular plant sci-

ence teaching program. Two upper-level laboratory courses are affected: Plant Physiology, and Plant Growth and Development. Plant Physiology currently is undergoing complete renovation; Plant Growth and Development is a new course, offered for the first time in 1987-1988.

The equipment is fitting out two entire laboratory courses in a manner that allows students to observe fundamental principles in plant biology and to gain experience in methodologies currently employed in plant science laboratory research. As a direct result of this grant, students are having an opportunity to utilize the following techniques in their study of plant processes: fluorescence and gas exchange at the whole leaf/whole plant level, organelle isolation and characterization, suborganelle fractionation, polarographic gas assay in solution, electrophoretic separation of proteins and quantification by scanning densitometry, immunochemical assays including Western blots and enzyme-linked immunosorbant assays, and in vitro translations.

Plant molecular and cell biology currently are areas of intense research efforts which are generating a great deal of excitement. An objective of this project is to transmit some of that stimulation to the local level. Some of the equipment also is being used in other upper-level laboratory courses by biology majors, a majority of whom continue their formal education in either graduate or professional schools.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

|                          |             |
|--------------------------|-------------|
| Sergio Aragon            | USE 8851530 |
| San Francisco State Univ | \$39,327    |
| San Francisco, CA        | Biology     |

#### **"Ultraviolet-Visible Spectrophotometers for Undergraduate Biochemistry Laboratories"**

The goal of this project is to improve the undergraduate laboratory curriculum by incorporating student work utilizing microprocessor-controlled ultraviolet-visible spectrophotometers. These are used primarily in three upper division laboratory courses; Biochemistry Laboratory and the two-semester Integrated Laboratory. All undergraduates take one or more of these courses, and so receive training in the theory and practice of this instrumentation. These new spectrophotometers introduce important new learning capabilities: flexibility for conducting new experiments as well as updating present experiments, the introduction of derivative spectroscopy in qualitative and quantitative analysis, efficient and rapid data acquisition coupled with powerful data processing capability, training in the practice of computer-interfaced instrumentation for data storage and retrieval, post acquisition processing and computer remote control, and the production of graphical results and spectral manipulations such as least squares fitting, peak integration and spectral subtraction.

A solid set of scientific and pedagogical goals is being pursued in this project. Eight specific experiments requiring modern spectrometers are being adopted. While the previous classroom curriculum covered the theoretical aspects of modern spectroscopy, laboratories were burdened by a lack of modern instrumentation. Since the department strongly stresses the "hands-on" experience required for careers in modern chemistry, biochemistry and biotechnology, the lack of proper spectrophotometers was particularly acute. The courses being improved serve as an important training ground for employment in high-technology industries in the Bay Area, as well as for the approximately 30-40% of this department's graduates who matriculate to post-baccalaureate studies.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

|                          |             |
|--------------------------|-------------|
| Jennifer Breckler        | USE 8852338 |
| San Francisco State Univ | \$47,200    |
| San Francisco, CA        | Biology     |

#### **"Undergraduate Laboratory Instrumentation For Cell Biology"**

The new instruments provided through this award, along with equipment already held by the department, is supporting the creation of an important new central laboratory facility for teaching cellular biology. The facility serves seven upper biology component. Of these courses, four use the facility on a full-time basis; the remaining three courses utilize the facility on a pre-arranged academic schedule to conduct laboratory exercises which require cell biology instrumentation.

The new equipment is being used for the preparation and analysis of living cells. Major items include laminar flow hoods, a fluorescence microscope, an infrared gas analyzer, and a scanning spectrophotometer. As a direct result of the acquisition of this equipment, the core curriculum in cell biology is being substantially upgraded. The project permits the development of new cell biology experiments, lower division demonstrations, and the improvement of existing lab exercises. These improvements are bringing state-of-the-art techniques to the curriculum and reinforcing the teaching of modern cell biology principles, thus better preparing undergraduates for future jobs and/or graduate studies.

The grantee is matching the NSF award with a slightly greater sum obtained from non-Federal sources.



Tracy L. Simpson  
University of Hartford  
West Hartford, CT

USE 8851605  
\$56,564  
Biology

#### **"Equipment for an Investigation-Centered Undergraduate Cellular Biology Laboratory"**

Sophomore and upper-level biology majors, while grounded in the facts of biology, routinely are grossly lacking in an understanding and appreciation of the overall significance of experimental laboratory results. This project addresses this deficiency by establishing a new cell biology laboratory using microscopic techniques exclusively for the elucidation of (1) cell and tissue structure, (2) localization and structure of tubulin and microtubules, and (3) the localization and structure of mitochondria and succinic dehydrogenase. These are being accomplished using histological procedures, bright field microscopy, semithin sectioning, transmission electron microscopy, indirect immunofluorescence microscopy, phase contrast microscopy, and cytochemistry of frozen sections at the light microscope level.

The following major equipment is being purchased in order to establish this laboratory: ultramicrotome, fluorescent microscopes, cryostat and student microscopes. The investigations are being carried out and then used by students as a basis for elucidating the limitations of biological techniques and the incomplete nature of experimental results. Equally significant, this new laboratory provides first-hand, detailed learning of a variety of modern, up-to-date, microscopical techniques. This cell biology course is populated by pre-health professionals, by health professionals who are continuing their education and training, by prospective high school biology teachers, and by a sizeable group of majors.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Dorene L. Petrosky  
Delaware State College  
Dover, DE

USE 8852969  
\$21,360  
Biology

#### **"Biology Laboratory Equipment to Support Undergraduates' Studies of the Health Problems in Black Americans"**

Laboratory exercises for various courses are being developed to illustrate underlying biological principles related to major health problems in Black Americans. These activities include electrophoresis of normal and sickle cell hemoglobin, fluorescent antibody demonstration of proteins associated with Graves disease and sickle cell patients, cardiovascular system activities related to hypertension in Black Americans, and biochemical tests to illustrate diabetes, lactose intolerance, and glucose-6-phosphate dehydrogenase (G6PD) deficiency.

Four student stations for electrophoresis experiments, biochemical studies and microscopic work are being set up. In addition, two analytical balances, two pH meters, two variable speed centrifuges, one inverted phase microscope, one fluorescent phase video microscope for class demonstration, and one transfer hood are being installed. Capabilities for the hypertension studies already are available. The project motivates all students, especially minorities, to maintain their efforts in pursuing a biomedically-related career. In addition, the laboratory activities developed will be made available as a laboratory manual for other institutions.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Harry Wistrand  
Patricia M. White  
Agnes Scott College  
Decatur, GA.

USE 8852671  
\$32,545  
Biology

#### **"Instructional Equipment to Improve Undergraduate Molecular and Cellular Biology Laboratories"**

To provide students with experimental knowledge of key aspects of cellular structure and function, this department is adding laboratory exercises to its Cellular and Molecular Biology programs. Laboratory work is being provided for the first time in conjunction with Molecular Genetics; a project in molecular genetics is being added to Microbiology; improved experiments in cellular biochemistry, respiration, and photosynthesis are being introduced into the Cellular Physiology and Biochemistry laboratories.

These laboratory improvements required the new equipment that is being provided through this project. The equipment includes: gel electrophoresis and blotting equipment, a sequencing gel reader, two centrifuges, a refrigerator, a -70°C freezer, water baths, a gel photographic unit, an analytical balance, a table-top autoclave, an orbital platform shaker for gel staining procedures, a microprocessor-controlled UV-visible spectrophotometer, a tissue homogenizer, and oxygen-monitoring systems.

With this equipment, students can do investigations in areas previously studied only through lectures and reading. The combination of theoretical and experimental understanding of cellular biology made possible by the new laboratory activities provides preparation essential to their pursuit of advanced degrees and careers in the life sciences.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Peter J. Adragna  
Aurora University  
Aurora, IL

USE 8852996  
\$5,960  
Biology

#### **"Computerization of an Undergraduate Physiology Laboratory"**

This project continues a curricular plan initiated to improve undergraduate learning in anatomy and physiology. The plan began with an institutional grant that provided computer software development to augment the anatomy-physiology lecture series. The Science Division developed a microcomputer laboratory with eight Apple 2E microcomputers, color monitors, disk drives and an Apple printer. A pilot study of computerized data acquisition in physiology laboratories proved to attract student interest. Further investigations and an actual on-campus Intelitool demonstration preceded the developmental work that led to this grant.

The primary objective of the current phase of the project is to interface computer technology with the biology laboratory by using the Intelitool computerized system and programmable calculators. The Intelitool system stimulates experimental inquiry and research by providing data acquisition and analysis using Cardiacomp, Physiogrip, Spirocomp, and Flexicomp packages. Creative laboratory experiments are designed to maximize critical thinking and analysis. Additional printers provide students with printouts of graphs and data sheets. Programmed calculators enhance statistical analysis and increase time devoted to the interpretation of actual data. Besides improving the physiology curriculum, this project also is expected to encourage student interest in scientific research, increase the number of students going on to graduate work in science (including women and minorities), and expose science student teachers to modern computerized laboratory technology.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Harvey V. Davis  
Columbia College  
Chicago, IL

USE 8852558  
\$17,909  
Biology

#### **"Modernization of Undergraduate Biology Laboratory Programs for Communications Majors"**

This institution specializes in training future communications professionals, among whom are significant proportion of minorities. The Science Department provides instruction in basic science which is integrated with the students' communications specialties through the preparation of reports such as videotapes or films on individual research projects.

One of the shortcomings of the students' training has been the lack of experience with modern instrumental

techniques. The instruments purchased through this project have applications in all Biology laboratory courses, and are available for use in students' research projects. As a result of this improved science training, it is expected that graduates, in their future careers in communications, will be able to report more effectively to the public on matters of science and technology.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

James Burnett  
Illinois Eastern Community College  
Olney, IL

USE 8852522  
\$8,070  
Biology

#### **"Instructional Equipment to Support Undergraduate Field Studies in Aquatic Microbiology"**

This aquatic microbiology project provides two-year college students with the opportunity, instruction, and equipment necessary to conduct quality field work. One of the great resources of Southern Illinois (and all of the Midwest) is the abundance of water. This project targets these resources by focusing student experiences on the microorganisms of aquatic ecosystems.

Initial work on this project began during the summer of 1987 with the addition of two new courses: Field Biology and Research in Biological Science. This curriculum addition, combined with new equipment purchases, represents the faculty's determination and commitment to link the classroom with the world of living organisms. To support this project the NSF award has financed the purchase of a quality microscope with phase contrast, epifluorescence and photomicrographic accessories, as well as a small utility boat with equipment for sampling lake and reservoir sediments. With these equipment additions, the aquatic microbiology students are being given an opportunity to combine the excitement and motivation of field work with experience in conducting sound scientific inquiry.

Students enrolled in these courses are largely those in the college's four-year transfer program who look forward to completing the baccalaureate in a science-related field. Through reports by these students often presented to local high school classes and to community adult groups, the project also contributes to better public understanding of science and to increased pre-college student interest in science careers.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Marian Smith  
Southern Illinois University  
Edwardsville, IL

USE 8851589  
\$9,710  
Biology

#### **"Modern Instrumentation for Teaching Undergraduates to Measure Photosynthesis"**

This project is designed to broaden and strengthen the undergraduate program in Biology, with particular impact on departmental majors whose programs emphasize the subdisciplines of Botany or Ecology. The acquisition of a modern photosynthesis instrument system (portable infrared gas analyzer which measures photosynthetic gas exchange and instantaneously computes photosynthetic rate, water-use-efficiency, intercellular CO<sub>2</sub> concentration, and stomatal conductance) will allow the introduction into the curriculum of modern courses in Plant Physiology and Plant Physiological Ecology.

The photosynthesis system will be used by students in the laboratory and in the field to measure and evaluate the interrelationship between plants and the environment. This system is ideal for teaching undergraduate students about plant physiological processes because it allows them to collect and analyze real data, thus creating a favorable climate for learning the scientific methods that are critical to designing and conducting meaningful experiments. The system also will be used for science demonstrations in outreach programs for pre-college students, thus serving the additional goal of interesting uncommitted students.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Richard S. Manalis  
Purdue University Fort Wayne  
Fort Wayne, IN

USE 8852393  
\$28,701  
Biology

#### **"Computer-Mediated Undergraduate Laboratories for Animal Physiology and Neurobiology"**

Physiology work stations which consist of modern data-taking equipment and Macintosh computers (which are well-known for their user-friendliness) are significantly improving the teaching of undergraduate students in this department.

Microcomputers used as scientific instruments in undergraduate teaching laboratories are perceived as being user-unfriendly by most students. This problem has been greatly reduced by the recent introduction of MACLAB by World Precision Instruments. MACLAB converts a Macintosh computer into a digital oscilloscope or chart recorder. One of the work stations in this project has a Macintosh II computer which functions not only as a digital recorder but also as a file server to the other computers in the network.

This allows physiology teachers to be innovative. For example, they are able to display previously recorded ex-

periments in class. Students can take physiology laboratory examinations ("lab practicals") using MACLAB. The high gain preamplifier (model 6132) manufactured by Palmer Bioscience is a versatile instrument which functions as an interface between a physiological transducer or a membrane potential measuring circuit and the MACLAB.

The work stations are used by students enrolled in Introductory Biology, Animal Physiology, Neurobiology, and undergraduate research. All major pieces of equipment are commercially available, thereby facilitating the incorporation of similar work stations into biology departments at other institutions.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Nancy P. Nekvasil  
St Mary's College  
Notre Dame, IN

USE 8851769  
\$10,230  
Biology

#### **"Equipment to Improve an Undergraduate Physiology Laboratory"**

The project goal is to upgrade the quality of the undergraduate Physiology laboratory by purchasing four 4-channel datagraph recorders which have the capacity to measure many of the important physiological parameters that are emphasized in the physiology courses. Previously only some of these phenomena were included in laboratory exercises due to equipment limitations. The scope of the laboratory portion of the physiology courses (which have served approximately 340 women students in the past five years) is being greatly enhanced.

The data graphs are being used, for example, to demonstrate blood pressure regulation, cardiac alterations in response to varying stimuli, and variations observable on the electrocardiogram when the subject is at rest or exercising. Previously there was no true exercise component to the lab experiments, not even in the areas of cardiovascular or respiratory physiology. The addition of these instruments to the laboratory permits the development of two important new exercises.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Lenore T. Durkee  
Grinnell College  
Grinnell, IA

USE 8851261  
\$49,844  
Biology

#### **"Scanning Electron Microscopy for Undergraduate Student Research and Instruction in Biology"**

This project provides a scanning electron microscope (SEM) to supplement the school's existing microscope fa-



cilities. The unique imaging capabilities of such an instrument provide information which cannot be supplied by either light microscopy or by a transmission electron microscope.

With this new instrument, the department can (1) modify the existing electron microscopy course to include all phases of specimen preparation and operation of the SEM so that students may use these techniques where appropriate in independent study and research, (2) help students become discriminating judges of the increasing amount of SEM evidence now presented in the literature of various disciplines, (3) utilize SEM in such courses as Principles of Biology, Cell Biology, Microbiology, and Systematics, in which scanning images serve as particularly useful instructional devices, and (4) make available and encourage the use of the instrument by students in other departments who require the kind of information that it can provide.

In the curriculum, this new machine is being used to demonstrate relationships between structure and function at a number of biological levels. Basic biological concepts (not just techniques) are being taught.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Marian M. Kaehler  
Luther College  
Decorah, IA

USE 8852615  
\$13,514  
Biology

#### **"Instrumenting a New Integrated Cellular/Molecular Biology Laboratory for Undergraduates"**

Molecular and Cellular Biology are viewed by this department as the primary instrumentation courses offered to majors. These courses are being integrated into a two-semester sequence, and have an extensive laboratory component located in a new molecular biology laboratory. Instruments with three experimental capabilities are being added or upgraded in order to maximize the effectiveness of students' experience: (a) polarographic equipment, (b) an ELISA plate reader and (c) equipment for quantitative assessment of gel electrophoresis runs utilizing photography, densitometry and autoradiography.

A quality laboratory experience should provide students with opportunities to do quantitative work as opposed to mere exercises for illustrating the principle or mechanism of a specific technique. This equipment permits a sophisticated level of hands-on experimentation, introducing students to the current concepts, terminology and techniques of the field. In addition to strengthening the Molecular and Cellular Biology courses, the instrumentation is enhancing laboratory work in Immunology, Endocrinology and Genetics, and significantly broadening the scope of Directed Student Research offered as part of the Biology curriculum.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Lloyd E. Story, Jr.  
Maysville Community College  
Maysville, KY

USE 8851279  
\$5,887  
Biology

#### **"Micro-Computer Interfaced Equipment for Instructional Laboratories in a Community College"**

The microcomputer hardware and software provided through this project are adding versatility to existing laboratory equipment and providing a new dimension to the science curriculum. It allows for the interfacing of microcomputers and transducers with existing hardware so that these two-year college students can perform laboratory experiments with greater rapidity, thus gaining more time for the interpretation of data, for better data analysis and for critical evaluation of the experimental designs and scientific methods being employed. Students are able to pursue independent problems and projects closer to the true nature of work done in professional scientific laboratories.

The video camera supplements students' individual use of laboratory microscopes, enabling the instructor to illustrate important microscopic concepts by projecting permanent or wet-mount slides so that they may be examined and discussed by all students at the same time. Life activities of microorganisms also can be observed simultaneously in the group setting.

All the new equipment provides students with greater opportunities to experience inquiry-centered instruction, thus helping them to build critical thinking skills. The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Beth E. Leuck  
Centenary College of Louisiana  
Shreveport, LA

USE 8851700  
\$6,753  
Biology

#### **"Computer-Assisted Data Acquisition in Undergraduate Physiology Laboratories"**

The goal of this project is to improve the quality of undergraduate laboratory experiences by equipping the organismal physiology laboratories with computer-assisted data acquisition apparatus. Three courses in the Biology Department (General Zoology, Human Anatomy and Physiology, and Animal Physiology) will be directly affected.

Previously, physiological experimentation in the laboratory sections of these courses was limited by inadequate equipment. The acquisition of computers, printers and appropriate hardware-software packages greatly enhances the ability of students to gather and analyze data. Six Laser 128 computers with monitors and printers and four software packages (Physiogrip, Spirocomp, Experiments in Human Physiology and Physiographic) constitute the suite of new equipment. These programs allow both majors and non-majors to collect data with a minimum of frustration, and



introduce undergraduates to sophisticated uses of computers in Biology.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Paul G. Greenwood  
Colby College  
Waterville, ME

USE 8852191  
\$33,475  
Biology

#### **"Fluorescence Microscopy for Undergraduate Teaching and Student Research"**

The fluorescence microscope has become an essential tool in many areas of research in the biological sciences. The localization of a variety of cellular structures using specific fluorescent markers or immunofluorescence is essential to much of our current understanding of such basic concepts as the cytoskeleton, cellular motility, and cellular transport phenomena. The aim of this project is to integrate fluorescence microscopy into the biological curriculum. A state-of-the-art microscope with capabilities for automatic photomicrography and for phase-contrast, differential interference-contrast, and incident-light fluorescence microscopy (in concert with video monitors and cameras and with additional microscopes with appropriate capabilities) is being used in the laboratories of several courses.

The major application is in a new course in Cellular Dynamics where fluorescence microscopy enables undergraduates to investigate the regulation of a variety of cytoskeleton-mediated events and receptor-mediated endocytosis. Additional applications are in the teaching laboratories associated with courses in Animal Cells, Tissues, and Organs, in Microbiology, Topics in Molecular Biology, and Genetics. These applications make it possible for the faculty to stress the integration of biological principles over a broad spectrum of courses. Thus the project provides students with the unique opportunity to learn many of the applications of fluorescence microscopy through experimentation in a variety of laboratories.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Ali Akbari  
University of Maine Fort Kent  
Fort Kent, ME

USE 8851421  
\$48,750  
Biology

#### **"Undergraduate Laboratory Equipment for an Environmental Monitoring Technology Program"**

The project's aim is the development of a new technical curriculum in environmental monitoring using state-of-the-art methods and technologies. Included in the equipment provided through this award are a gas chromatograph/mass

spectrometer (GC/MS), a separate GC, a high performance liquid chromatograph (HPLC), an atomic absorption spectrometer (AA), and a modern, computer-linked weather station. With the help of this equipment, students learn the procedures and principles involved in analyzing indoor and outdoor air, water, soil, and animal and human tissue for the presence of environmental contaminants resulting from agricultural and forestry pesticides, hazardous wastes, and industrial emissions. The resulting new curriculum, backed by the institution's excellent computer facilities, gives a technical focus to the existing B.S. in Environmental Studies Program and makes possible the institution of a new A.A. degree program in Environmental Monitoring Technology.

The project addresses the Nation's growing need for competent pollution and hazardous substances control technicians, provides skilled manpower for Northern Maine's environmental laboratories, and affords opportunities for upward mobility to the economically depressed predominantly French-American (Acadian) people of the St. John Valley in Northern Maine which the institution serves.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Gerald D. Robinson  
Towson State University  
Towson, MD

USE 8851942  
\$23,091  
Biology

#### **"Biological Equipment for Teaching Instrumental Methods to Undergraduates"**

The Department of Biological Sciences is improving its curriculum by introducing an interdisciplinary team-taught course, Instrumental Methods for Biologists. This course corrects a perceived deficiency in the undergraduate training of biologists with regard to the theory and application of sophisticated instrumentation.

Through the combined use of its existing facilities and the additional equipment acquired through this project (and with valued assistance from the Department of Chemistry), the Biology faculty is bringing to its majors fresh insights into the principles of electronics, modern data management, analytical techniques, and physiological monitoring methods. While the new course, "Instrumental Methods for Biologists", is targeted for second- or third-year Biology majors, Chemistry and Physics majors also are invited to enroll in it.

Inclusion of this course in the Biology curriculum provides students with a foundation in the analytical and evaluative techniques that are focal to their fields of inquiry, thus accelerating their transition into competent professionals. This course is facilitating the development of enthusiastic, instrumentation-literate scientists at this university.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Peter J. Gruber  
Mount Holyoke College  
South Hadley, MA

USE 8851401  
\$37,053  
Biology

#### **"Equipment to Modernize an Undergraduate Physiology Curriculum"**

While students were receiving a modern view of physiology in their classrooms, their physiology laboratory experiences before the advent of this project in many instances were quite inadequate. Many of introductory and intermediate-level laboratories or projects were of a descriptive rather than an analytical nature. Other physiology-related laboratories or projects employed somewhat primitive equipment. A modern study of physiology even at the undergraduate level requires considerably more sophisticated equipment and methodologies than were available.

The objectives of this project are to enhance the quality of the laboratory in several physiology-related courses by moving the laboratory experience from the descriptive to the analytical. With the new equipment and the new or modified procedures recently introduced, students are able to make accurate collections of complex and meaningful data and to analyze it in the manner of the modern physiologist. Equipment includes a number of different transducers, and two multipurpose minicomputers complete with the hardware and software needed to interface with this equipment in a number of different configurations to study elements of both plant and animal physiology.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Robert N. Leamson  
Southeastern Massachusetts University  
North Dartmouth, MA

USE 8851458  
\$20,812  
Biology

#### **"Equipment for Isolating Plasmid DNA and Cytochrome p450 in Undergraduate Laboratories"**

This project introduces into undergraduate physiology, biotechnology and molecular biology laboratories a set of new experiments that involve the isolation of the microsome component of cell lysates and closed-circular, non-chromosomal DNA from bacteria. The new ultracentrifuge procured through this project is used to isolate the microsome fraction from cells of marine animals that have been exposed to xenobiotics (artificially exposed in the laboratory or exposed via polluted waters). Students study the effect of xenobiotics on the quantity and functions of the mixed function oxidase system, a cytochrome p450.

In other experiments, students use ultracentrifugation to isolate and characterize either large endogenous plasmids from *Thiobacillus versutus* or closed-circular DNA vectors carrying a variety of inserts. (Such isolations normally involve overnight centrifugation in cesium chloride/ethidium

bromide, with or without prior high salt/SDS treatment.) An additional longer-term goal is for students in undergraduate research projects to isolate from sucrose gradients *E. coli* minicells containing the *T. versutus* plasmid. In all cases the expertise and support materials had been available to do these projects, but a reliable ultracentrifuge was not. The new equipment, therefore, is facilitating useful and important curricular changes.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Barbara S. Beltz  
Beverly A. Blazar  
Wellesley College  
Wellesley, MA.

USE 8851888  
\$40,742  
Biology

#### **"Immunological Techniques in the Undergraduate Laboratory"**

Equipment secured through this project is being used to expand the variety of immunological methods taught to undergraduates. Specific goals are (1) to incorporate assays into laboratory sessions to study ongoing immunological activity; and (2) to localize and quantitate antigens in tissues and on cells. Specific methods used are: immunocytochemistry, radioimmunoassay, blastogenesis assays, interleukin production, western blots, and 51-chromium release assays. Several major pieces of equipment are crucial to this program: a cryostat, cell harvester, CO<sub>2</sub> incubator, gamma counter, sterile benches, -75 degree freezer, and a centrifuge.

Because the methods being introduced encompass several disciplines, specific laboratory experiments using this equipment involve a variety of courses that will affect approximately 1,250 students over the next five years. The exercises developed as part of this program will enhance the sophistication of the overall experience available to these undergraduates in an important new area of Biology, providing them with a deeper understanding of the immune response and of the uses of immunological techniques to detect molecular change. This area has grown exponentially in the last two decades. Both clinically and experimentally, new assays have made it possible to localize and quantitate molecules heretofore unknown.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Edmund Y. Tong  
Wheaton College  
Norton, MA

USE 8852416  
\$17,370  
Biology

#### **"Microcomputer-Controlled Instrumentation for an Undergraduate Physiology Laboratory"**

Although the implementation of computer use in undergraduate education had successfully permeated every

facet of this department's curriculum, the microcomputer application to data acquisition and analysis had not yet been initiated systematically. Outdated physiological instruments had started to become a hindrance to the full development of the instructional program. With equipment provided through this project, the faculty is revising and upgrading the student work stations with microcomputer-interfaced instrumentation.

Modernization of the Introductory Physiology laboratory benefits many related upper-level courses. Students are able to engage in hands-on experimentation with improved quality and quantity. They also gain easier access to computer simulations and computer-aided lessons. Furthermore, they have a chance to learn and master state-of-the-art techniques in data acquisition and analysis. Finally, the new instrumentation permits new experiments and research projects to be developed for independent research and senior honors work, an important part of the institution's ongoing efforts to provide its women a strong basic science foundation for graduate studies and subsequent careers in science.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Craig A. Weatherby  
Adrian College  
Adrian, MI

USE 8851477  
\$22,174  
Biology

#### **"Equipment for an Undergraduate Program in Animal Behavior Communication and Ecology"**

This project is enhancing the capability of the Biology Department to provide laboratory experiences which illustrate and test theories of animal behavior, communication, and ecology that are introduced in the lectures of six existing courses. In addition, it provides advanced undergraduate research opportunities in the disciplines of Animal Behavior, Communication, and Ecology; upgrades the animal behavior and ecology facilities (radio telemetry) currently existing at this institution, and adds to existing animal behavior and ecology facilities an important ability to analyze animal communications. With it, undergraduates have ready access to state-of-the-art, computer-interfaced sound spectrographic and video taping equipment for the analysis of animal communication.

All this enhances the undergraduate Biology majors' opportunities to become researchers at the entry level and to increase these skills at the independent research level. The Department is conducting a special program for recruiting talented minority members into this sequence.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Daniel J. Hornbach  
Macalester College  
Saint Paul, MN

USE 8852273  
\$41,586  
Biology

#### **"An Undergraduate Computer Laboratory for the Biological Sciences"**

Computer technology is playing an increasingly important role in the biological sciences. Computers are being used for data acquisition and analysis, and they make the simulation of complex biological systems possible. Despite their importance, the integration of computers into the undergraduate Biology curriculum has not been consistently achieved. This means that students often underestimate the need for quantitative skills in modern biological research.

This project attempts to overcome this problem by developing a computer laboratory for the biological sciences. The laboratory is being configured with a network of 12 MacIntosh II computers to allow for interaction among the instructor and students. One of the main uses of the lab is to allow students to develop their analytical skills by designing simulation models of biological processes. Simulations are used in the department's Ecology, Limnology, Human Physiology and Research courses. The new equipment also supports the development of an Evolution course in which the majority of the labs are to be based on model building. In addition, the lab is used by students in a number of classes to acquire data from scientific instruments and to conduct the subsequent statistical analyses of these data. Finally there are plans to use the computer lab for literature searching and accessing external databases through the college's local area network.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Bertha L. Proctor  
Mankato State University  
Mankato, MN

USE 8851174  
\$29,865  
Biology

#### **"An Atomic Absorption Spectrophotometer/Graphite Furnace for an Undergraduate Interdisciplinary Environmental Science Program"**

This department stresses a program of quantitative training to help undergraduates develop skills necessary for biologists and environmental scientists in the next decade. A Perkin-Elmer 5100 Atomic Absorption Spectrophotometer-Graphite Furnace (AA-GF) system with Zeeman background correction is facilitating instruction in Biology Department programs, including Environmental Sciences, Toxicology, Microbiology, and Botany, and is encouraging development of more interdisciplinary undergraduate courses and projects.

The AA and GF are essential tools for the quantification of metals in a variety of matrices. Projects have been de-



signed in five courses to instruct students in the theory, advantages, limitations, and proper uses of AA and GF. Instrumentation maintenance and quality control/quality assurance procedures are an integral part of all courses and projects. Student projects involve use of the AA and, where appropriate, the FA as detectors of metal contaminants in water, soil/sediments, biological fluids, tissues, and air. They also are used to measure bioaccumulation of metals in terrestrial/greenhouse studies and to monitor the levels of toxic metals added to tissue cultures for chronic and acute toxicity testing. Research and development of new methods for use of the GF and AA should give complete instruction of uses, advantages, and limitations of these tools.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Janet C. Woodard  
Denise M. McGuire  
Saint Cloud State University  
Saint Cloud, MN.

USE 8852090  
\$11,152  
Biology

#### **"Instrumentation to Develop an Undergraduate Immunology Program"**

The Department of Biological Sciences is committed to teaching students an understanding of biology through participation in scientific experimentation. In addition to a better understanding of science, participation in the process of science teaches students valuable skills for today's job market. To meet the increased need for graduates who can bring an understanding of immunology to their advanced studies as well as Minnesota's growing biotechnology industry, the Biology department currently is updating and expanding this area of its curriculum. This is being achieved by hiring a new faculty member with up-to-date knowledge in immunology and purchasing an initial suite of equipment.

The goal of this project is to complement the original equipment purchases with items commonly used in modern immunological technology. This allows the Department to offer a program in immunology that aids students in their understanding of biology and also prepares them for employment opportunities in local industry.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Richard V. Kowles  
St Mary's College  
Winona, MN

USE 8852046  
\$15,529  
Biology

#### **"Standard and Fluorescence Cytophotometry Equipment for the Undergraduate Curriculum and Student Research"**

This Biology Department has identified an opportunity to improve and diversify its laboratory capabilities in five

upper division biology courses and in the undergraduate student research program. This entire array of objectives will be met by the acquisition of the components needed to build upon and complete a sophisticated cytophotometer system with fluorescence capabilities; that is, a functional unit which the Department had previously begun to assemble with their own resources.

The added laboratory activities will include measurements of DNA content, cell cycle studies, and chromosome analyses in genetics; cytochemistry and fluorescence microscopy in cell biology; fluorescence cytophotometry and biotinylated DNA hybridization in molecular biology; microbe identification in microbiology; indirect fluorescence and direct immunofluorescence in immunology; and a number of qualitative and quantitative techniques and additional undergraduate research options. Scientific advances in certain aspects of biology which heavily utilize these techniques coincide very well with the nature of the curriculum, faculty expertise, and student interest here.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Gary D. Sells  
Northeast Missouri State University  
Kirksville, MO

USE 8851433  
\$62,000  
Biology

#### **"Laboratory Improvement for Cell Biology"**

This project is providing instruments that improve five areas of a Cell Biology laboratory. An incubator and muffle furnace aid efforts to determine composition of cells. A photomicrographic microscope with capability to detect fluorescence is used to locate specific antigens by using FITC-antibodies. A cryostat is used to section fresh tissue that, selectively stained, is used to identify the cellular locations of specific molecules. Oxygen probes with accessories are used to follow electron flow rates in mitochondria and chloroplasts. A recording UV-VIS spectrophotometer enables undergraduates to do absorption spectra and to analyze enzyme reactions. Finally, electrophoresis chambers and a densitometer are used in the analysis of isozymes and the characterization of DNA.

The objective is to raise the level of involvement of sophomore Biology students in investigations of cell function. Early involvement of students in cell biology experiments is expected to result in higher scores on senior exams in the Cell Biology/Molecular section of the Graduate Record Examination.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.



Christopher C. Field  
Southwest Missouri State Univ  
Springfield, MO

USE 8852048  
\$14,827  
Biology

#### **"A Tabletop Ultracentrifuge for Teaching Undergraduate Cellular & Molecular Biology"**

A curriculum in Cellular and Molecular Biology has been under development in the Biology Department for two years. The purpose is to provide a program which affords an option in Cellular and Molecular Biology to departmental majors, supports other intra- and inter-departmental programs, and provides a background for students interested in doing undergraduate research in these areas.

Recent developments include approval of an introductory course in Molecular Biology for sophomore students and the restructuring of existing courses. The tabletop ultracentrifuge provided through this award was needed to carry out laboratory exercises essential to the program, support student research projects and to provide practical experiences that reinforce pedagogical material covered in lectures. The tabletop model not only is suitable for all these uses, it also is less expensive to purchase and maintain, requires lower expenditures for materials, and is both easy and safe to use.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

James D. Hoerter  
Stephens College  
Columbia, MO

USE 8851225  
\$15,000  
Biology

#### **"Instrumentation to Support Student Research in Molecular Biology by Undergraduate Women"**

The objectives of the molecular biology research laboratory for undergraduate women in science are: (1) to establish a state-of-the-art research laboratory in molecular biology to prepare women for biomedical careers and/or graduate research; (2) to strengthen the College's existing research internship program by establishing an on-campus lab equipped to permit more sophisticated student research and independent study; and (3) to foster a "partners in scholarship" atmosphere for faculty and students in the Biology Department.

The acquisition of the electrophoresis apparatus, centrifuges, a spectrophotometer, and support instrumentation (incubators, sterilizer, orbital shaker) are modernizing the laboratory for student research in molecular biology. This lab enables students to learn the latest techniques employed in studying the molecular biology of proteins and nucleic acids, and then permits them to apply these techniques by designing and carrying out an independent research project. Research projects culminate in a seminar presented to the Missouri Academy of Science and a re-

search manuscript. Some of the latter have proved to be suitable for publication.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Lonnie J. Guralnick  
Rocky Mountain College  
Billings, MT

USE 8851150  
\$15,500  
Biology

#### **"Equipment to Improve the Undergraduate Biochemistry Laboratory Program"**

The goal of this project is to provide equipment to support the initiation of a biochemistry laboratory and senior-year research programs. The equipment is for centrifugation, spectrophotometry, and potentiometric techniques.

The Biology Department is revising its curriculum in order to offer a greater focus on the health sciences. The restructuring already has doubled departmental enrollments. The new equipment is helping to produce graduates who are better prepared for advanced study and better able to serve the community at large.

The grantee institution is matching the NSF award with a substantially greater sum obtained from non-Federal sources.

Robert M. Arnold  
Colgate University  
Hamilton, NY

USE 8851474  
\$18,321  
Biology

#### **"Computers for Undergraduate Ecology and Population Biology Laboratories"**

The Department of Biology is making IBM-compatible microcomputers available to its students at all levels of the Ecology curriculum. The inadequate computer hardware and software within the Department previously available for student use is being augmented by laptop microcomputers to collect and analyze data both in the field and in the laboratory; external hard drives to provide storage space for data; professional-level statistical software packages; dot-matrix printers; a plotter; and a video projection system.

The courses in which computers are having the greatest immediate impact are "Computers in Biology" and "Ecology", both of which are intermediate-level courses, and "Population Biology", an advanced-level seminar course that includes an independent research project. Other courses that benefit from the equipment include "Introductory Biology", "Limnology", and advanced-level research oriented courses. The computer expertise developing in the Department, together with a strong university commitment to computing, justify the development of a Biology curriculum in which computers play an important role.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

|                        |             |
|------------------------|-------------|
| Pierre-Yves Bouthyette | USE 8851864 |
| Elmira College         | \$20,781    |
| Elmira, NY             | Biology     |

**"Establishment of Subcellular Fractionation Capabilities for Undergraduate Coursework and Student Research"**

The ultracentrifuge obtained through this project is enabling the Division of Natural Sciences to develop complete subcellular fractionation capabilities in order to upgrade the curriculum in Biochemistry and Molecular Biology, as well as to add important new options to the undergraduate research program. Experiments have been designed for the isolation of plasma membranes, tonoplast membranes and other subcellular fractions, of such proteins as the ATPase and of viruses, plasmids and nucleic acids that require the use of an ultracentrifuge.

These new experiments are being incorporated into the curriculum in order to take advantage of faculty expertise in this field; to enable students to perform advanced experiments involving the isolation of subcellular fractions, proteins and nucleic acids; to extend and integrate use of other equipment such as the High Performance Liquid Chromatograph (HPLC), liquid scintillation counter and gas chromatograph, and to provide students with practical experience in the growing number of areas in Biochemistry, Cellular and Molecular Biology that require advanced subcellular fractionation.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

|                               |             |
|-------------------------------|-------------|
| Matthew J. Temple             | USE 8853194 |
| Nazareth College of Rochester | \$10,988    |
| Rochester, NY                 | Biology     |

**"Computerized Image Analysis of Biological Data in Undergraduate Instruction"**

This project brings quantitative depth and rigor to students' visual data by installing three complementary systems: (1) a computerized image analyzer; (2) a color video camera and recorder; and (3) Nomarski optics to upgrade an existing phase-contrast microscope. This equipment, along with a fluorescence photomicroscope obtained through a NSF grant in 1985, enables the immediate introduction of image analysis into these laboratory courses: Cell Biology, Immunology, Genetics, Plant Biology, Biological Systems, Contemporary Biology for non-majors, and Senior Research.

Computerized image analysis enables students to accurately and rapidly measure the size, shape and density of microscopic and some macroscopic objects, to statistically analyze these data, and to incorporate images and statistics into a single computer-generated lab report. The project enables both upper- and lower-level Biology students to transform initial qualitative perceptions of visual data into statistically-supported conclusions.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

|                 |             |
|-----------------|-------------|
| Lise D. Wilson  | USE 8852776 |
| Siena College   | \$19,518    |
| Loudonville, NY | Biology     |

**"Introduction of Molecular Genetics Techniques into the Undergraduate Curriculum"**

The goal of this project is to introduce current techniques in Molecular Genetics into the undergraduate Biology curriculum. The equipment it provides is making it possible to offer a new laboratory course in Molecular Biology, as well as to improve the present Cell Biology, Microbiology, and General Biology course laboratories. Approximately 170 students per year, at all undergraduate levels, will be affected by these changes.

The new equipment includes a bacteriologic incubator and water bath shaker to culture bacteria for the isolation of plasmids; a CO<sub>2</sub> incubator and laminar-flow clean benches for student work with tissue culture; microcentrifuges for DNA/RNA purification and concentration; horizontal agarose gel units and a DNA-detection camera system to separate and analyze the products of restriction enzyme digestions; a polyacrylamide slab gel unit to analyze the products of in vitro transcription reactions; fluorescence illuminators to detect the cell-surface expression of the product of a transferred gene; and an ultraflow freezer for the long-term preservation of the bacterial strains and cell lines used in the experiments described.

By acquainting students with the methodology involved in molecular cloning and gene expression, this project is enhancing their academic experience, increasing their awareness of the scientific process, and preparing them more fully for scientific careers.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

|                      |             |
|----------------------|-------------|
| Sherilyn G. F. Smith | USE 8852897 |
| Skidmore College     | \$7,704     |
| Saratoga Springs, NY | Biology     |

**"Instrumentation to Improve Undergraduate Laboratory and Field Studies in Organismic Biology"**

In the area of Organismic Biology, this Department offers courses ranging from Physiology to Genetics to Ecology.

If students are to fully appreciate the scope of these topics, they must become actively engaged in laboratory and field studies using current techniques. The goal of this project is to incorporate an EGC controlled-environment chamber, a HACH spectrophotometer, a Sartorius top loading balance with computer interface capability (all for laboratory use), a HACH portable testing "laboratory" and a LICOR data logging system (for field use) into the Department's instructional program.

These instruments are significantly improving laboratory and field instruction in organismic biology, particularly in Physiology and Ecology, by allowing students to experience first-hand such concepts as the effects of temperature on physiological processes and on population growth rates, and the nature of nutrient dynamics in aquatic and terrestrial ecosystems. Students also benefit from seeing how up-to-date equipment and research techniques are applied to examining modern biological hypotheses. Courses at the introductory, intermediate and advanced levels are affected, as is the Senior Thesis Research program.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Mark A. Schlessman  
Vassar College  
Poughkeepsie, NY

USE 8852608  
\$48,900  
Biology

#### **"Equipment for Teaching and Student Research in Plant Ecology and Evolutionary Biology"**

The equipment purchased through this project is to improve laboratory instruction and enhance opportunities for undergraduate student research in Plant Ecology and Evolutionary Biology. Several functionally related items being installed include plant growth chambers, balances, a portable photosynthesis system, a portable leaf area meter, a datalogger, and equipment for extracting biochemical compounds from plant tissues. This new equipment responds to increased student interest in ecology and evolutionary biology by assisting the faculty to (1) introduce new courses in Aquatic Biology and Population Biology, (2) add a new laboratory component to the existing Evolutionary Biology course, (3) improve laboratory instruction in five other existing courses, and (4) increase the kinds of projects that students may conduct as independent research.

In the instructional laboratories, the new equipment is being used in a variety of exercises that include investigations of the effects of environmental parameters on plant growth, development, and metabolism in both natural environments and under controlled conditions; experimental studies of plant competition under controlled environmental conditions; and studies of the inheritance of traits affected by many genes (quantitative traits).

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Mary U. Connell  
Appalachian State University  
Boone, NC

USE 8853233  
\$20,724  
Biology

#### **"Undergraduate Investigative Laboratories for Understanding Physiological Systems"**

The areas of Cellular/Molecular Biology and Physiology are becoming increasingly difficult to teach because of the rapid advance of knowledge and the technical methodologies they employ. Compounding the already difficult task of instruction is the students' lack of understanding of how to investigate physiological systems. These facts lead to the two main objectives addressed in the present effort to improve instruction in the affected laboratories: (1) To give students experience with suitable equipment in order to develop their understanding the behavior of physiological systems (using an instrument not only develops a student's lab skills; it encourages the development of a sophisticated understanding of the concept or system which can't happen in any other way). (2) To provide the student with a laboratory experience that is investigative in nature.

In order to accomplish these objectives, the Cellular/Molecular and Physiology laboratories are being restructured by developing three different types of labs: Concepts-Skills, Inquiry, and Investigative. These facilitate the exploration of topics in the lab which previously could be pursued only in lecture.

The above changes are intended to: 1) increase the students' understanding of the conceptual framework upon which a physiological/cellular/molecular investigation is based; 2) increase the students' ability to work with the type and quality of data gathered in cellular/molecular and physiological investigations; 3) develop in the students a sense of inquiry, understanding and appreciation of the functional aspects of Cellular/Molecular Biology and Physiology; and 4) increase the students' own investigative abilities.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Michael J. McLeod  
Belmont Abbey College  
Belmont, NC

USE 8851571  
\$11,650  
Biology

#### **"Equipment for an Undergraduate Laboratory Program in Cellular Biology"**

The Biology Department is updating and modernizing its Cell Biology course, particularly the laboratory component, as part of a general shifting of emphasis in the departmental curriculum. This is being accomplished in part by obtaining instrumentation needed to perform experiments in cell function and in DNA structure and function. These areas are important to a modern course in Cellular Biology.



Previously the laboratory portion of the Cell Biology course was organized in a classical manner, with a minimum of experimentation and analysis. With the acquisition of the new equipment, the course uses the accumulation and interpretation of experimental results to illustrate concepts and material. These instruments also are useful in the Genetics and Biochemistry courses. The equipment includes a refrigerated centrifuge, microcentrifuge, analytical balance, pH meter, and gel electrophoresis apparatus. With the new equipment, undergraduates perform basic experiments on DNA. These include the mapping of restriction fragments, and analyses of enzyme actions and kinetics.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

|                                  |             |
|----------------------------------|-------------|
| David W. Hollar, Jr.             | USE 8852752 |
| Roanoke-Chowan Technical College | \$5,749     |
| Ahoskie, NC                      | Biology     |

**"Computer-Interfaced Instrumentation for an Undergraduate Environmental Science Laboratory"**

The Science Department at this small, rural Community College is introducing environmental science-related computer-interfaced instrumentation into relevant science course offerings in its Associate degree programs. The project serves primarily minority and underprivileged college students from the Upper Coastal Plain Region of northeastern North Carolina, providing these individuals with an unprecedented science exposure.

Computer-interfaced environmental science experimentation provides opportunities to make precise measurements of chemical and physical processes relevant to environmental changes (e.g., climate, air and water quality, water and soil pH, optimal plant growing conditions, etc.). This project also provides capabilities for monitoring simultaneous experiments, storage and detailed analysis of data, experimental simulations, and student design of experiments. Finally, the revisions to the curriculum this project is making possible provide students with an exposure to science and to computer applications in science, enhancing their long-term ability to perform effectively in an advanced technological society.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

|                   |             |
|-------------------|-------------|
| David L. Quinn    | USE 8853032 |
| Muskingum College | \$14,421    |
| New Concord, OH   | Biology     |

**"Fluorescence Microscope with Computer Linkage to Support Undergraduate Studies in Physiology, Genetics and Anatomy"**

The goal of this project is to provide students an opportunity to conduct experiments with biological phenom-

ena at the cellular and molecular levels. The major new equipment includes a Nikon fluorescence microscope-camera system, a cryostat, and computer equipment linked to the fluorescence microscope through a closed-circuit video system for image analysis.

Fluorescence markers are used to study, e.g., human, animal and plant chromosomes, cellular development and brain pathways. Some current student research projects involve the activation of genes in the hippocampus, tracing neural pathways in the brain, verification of success of transplantation of adrenal medulla tissue to the brain, and sexual differentiation in the spinal cord. The computer equipment is being linked to the fluorescence microscope and image analysis programs written to support the various experimental protocols. Students can explore the molecular basis of life in the laboratory, becoming proficient with equipment that is linked to computer systems while experiencing the increased experimental design and analysis capabilities available through such systems.

This new equipment is enhancing biological laboratory work in Physiology, Genetics and Evolution, Introduction to Biology, and undergraduate student research.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

|                    |             |
|--------------------|-------------|
| Susan K. Hill      | USE 8853308 |
| Notre Dame College | \$11,126    |
| Cleveland, OH      | Biology     |

**"Improved Optical Microscopy to Enhance Undergraduate Biology Laboratories"**

The goal of this project is to upgrade the biological and technical training of women undergraduates through the improvement of their light-microscopy laboratory curricula. A major thrust of the project is to enable students to view living organisms and tissues, and to learn modern techniques for the examination and evaluation of living cells, cell processes and structures.

The addition of phase, polarized and fluorescence capabilities, and of stereo and inverted microscopes, increases the level of instructional sophistication and significantly upgrades the technical proficiency of emerging students. The new microscopes upgrade the entire departmental curriculum, greatly expanding the range of laboratory experiments available in each laboratory offering, and broadening independent student research program, thus making the women scientists emerging from this Department more competitive in today's competition for graduate school admission and for places in the scientific/technological labor market.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.



Jeffrey J. Sich  
Youngstown State University  
Youngstown, OH

USE 8851165  
\$26,799  
Biology

#### **"Instruments to Improve the Undergraduate Core Curriculum in Microbiology"**

Since 1980, and especially within the last three years, there has been rapid growth in the area of Microbiology in this Department. This is reflected in a 49% increase in the number of students enrolled in the basic microbiology course and the subsequent increase in demand for upper division courses. In response to this demand, a new faculty member, with expertise in immunology, was hired in 1986, providing the Department with the opportunity to expand its offerings in microbiology and to provide a core of courses approved by the American Society for Microbiology.

The equipment procured through this project is enhancing the laboratory experiences offered, and making it possible to offer additional courses in the near future.

A teaching microscope, compatible with a video display system, provides both an opportunity to improve instruction in microscopy and to use techniques in fluorescence microscopy. The equipping of a tissue culture laboratory permits the experimental manipulation of mammalian cells. Students also are gaining experience in immunoelectrophoresis, ELISA and other microtechniques, and in the manipulation and visualization of nucleic acids.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Maryanne McClellan  
Peter J. Russell  
Reed College  
Portland, OR.

USE 8852739  
\$93,560  
Biology

#### **"A Core Facility for Teaching Undergraduate Cellular and Molecular Biology"**

The recent impacts of Molecular and Cellular Biology on the theoretical framework of every biological subdiscipline are causing large numbers of undergraduates in this department to enroll in Cellular and Molecular Biology courses. Sophisticated aspects of molecular and cellular theory presented in lecture require students to reference the current literature frequently, and to engage in appropriate laboratory exercises. These pressures made previously available instructional instrumentation grossly inadequate, forcing the use of obsolete experimental designs.

This project is alleviating these difficulties by providing two refrigerated centrifuges, an ultracentrifuge and rotors, an inverted fluorescence photomicroscope, eight horizontal electrophoresis stations, a DNA sequencing system, apparatus for the separation of chromosome-sized DNA fragments, deep freeze, incubator/shaker, five UV/VIS re-

cording spectrophotometers, vacuum oven, photographic recording system for agarose gels, and a water purification system. The result is to provide sufficient numbers of modern centrifuges and spectrophotometers to execute smoothly laboratory experiments on subcellular fractionation, enzyme reaction kinetics, and molecular cloning; to permit curricular change in the form of advanced laboratory exercises such as macromolecular localization and DNA sequencing; and to make available state-of-the-art instrumentation for student research projects in all fields of biology.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Foster E. Billheimer  
California Univ of Penn  
California, PA

USE 8851166  
\$41,444  
Biology

#### **"A Scanning Electron Microscope to Improve the Undergraduate Biology Curriculum"**

The aim of this project is to improve the undergraduate curriculum of the Biological and Environmental Sciences Department through the acquisition of a Scanning Electron Microscope (SEM). The SEM makes it possible to obtain valuable information about the external and internal surface features of specimens and to provide students with increased understanding of structure-function relationships at the cellular level. Since there is such a rapidly expanding body of knowledge in the areas of cell biology and physiology, the Department faced a growing need to update undergraduate courses to provide a sound understanding of physiological processes at the cellular and subcellular levels.

The SEM is being used in the following courses: Techniques of Electron Microscopy, Cell Ultrastructure, Cell Biology, Human Physiology, Microbiology, and Biological Research Investigations. The instrument has been attached to a VCR and TV monitor which extends its instructional capabilities and makes it a uniquely flexible teaching tool. Biological specimens can be examined and videotaped, bringing the actual "search and discover" process beyond the lab into the classroom. Ancillary equipment for the preparation of specimens (a sputter coater and a critical point dryer) are included in the project.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Charlotte A. Zalewsky  
Carlow College  
Pittsburgh, PA

USE 8851936  
\$8,101  
Biology

#### **"Equipment for Improving Undergraduate Instruction in Physiology"**

The goal of this project is to upgrade the Physiology Laboratories of two courses: Anatomy and Physiology, and

Vertebrate Physiology. First, the acquisition of a dual channel recorder accessory transducers and preamplifiers for the existing Thornton physiographs, and the updating of existing physiographs with solid state electronics are resulting in the introduction of two new labs: a Cardiovascular Fitness lab and a Biofeedback lab; the reduction of lab group size, thus providing students with better opportunity for hands-on-experience; and the replacement of demonstration experiments allowing small groups of students to measure such functions as lung volume, EEG's, EKG's and volume pulse measurements in four different laboratories.

Secondly, a TRIAC centrifuge which spins microhematocrits, urine and blood tubes allows students to determine hematocrit for the first time and to perform urinalysis procedures in the Kidney Physiology lab. Thirdly, a T.V. videosystem introduced into eight labs having a Histology component is improving teaching and student use of labs dedicated to the teaching of microstructure. Lastly, a new still provides needed distilled water for physiological solutions.

The above developments encourage experimentation, foster students' understanding of physiological principles, challenge students to think analytically, and encourage technical competence of women, including large numbers of older minority women who are enrolled in the college's "Hill College" program for disadvantaged students.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

|                     |             |
|---------------------|-------------|
| Arthur R. Ayers     | USE 8852085 |
| Cedar Crest College | \$11,330    |
| Allentown, PA       | Biology     |

#### **"Undergraduate Research Groups—A Model Method for Teaching Genetic Engineering Technology"**

This project provides equipment needed to create a complete research environment as a training model within the Genetic Engineering Technology Program. This strong new program is designed to provide the conceptual and technical background needed for women to become leaders in professional fields based on modern biological research. The research environment permits training in the use of recombinant DNA techniques, DNA sequencing, and monoclonal antibodies, while teaching central concepts of Molecular Biology. Student research projects extend the use of relevant techniques to areas of active research, while developing self-confidence and independent thinking in women majoring in Biology.

The equipment (fluorescence microscope, chromatography cabinet, ultralow freezer, data acquisition computer and benchtop centrifuge) extends a successful curriculum and is housed in a new facility. With it, undergraduates can conduct research in the area of immunodiagnostics that is

of potentially publishable quality, lending greatly increased credibility to the training.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

|                        |             |
|------------------------|-------------|
| Allan F. Wolfe         | USE 8853192 |
| Lebanon Valley College | \$21,462    |
| Annville, PA           | Biology     |

#### **"Improvement of the Undergraduate Comparative Histology Laboratory Experience"**

Most of the students who enroll in the Histology course and its associated laboratory are Biology majors with plans to pursue graduate degrees or to attend professional schools. Historically, the laboratory part of this course included the study of prepared slides of various tissue types and organ systems, as well as the routine procedures for the histological and histochemical staining of paraffin-embedded tissues. The laboratory experience then culminated in a project which utilized some of the techniques learned in the course and was presented in a poster format.

Redesigning this course to improve laboratory study at the cellular biology level—fluorescence microscopy, ultrastructural studies, immunohistochemistry, and plastic embedding—provides Biology majors as well as Biochemistry majors with a strong morphological background at the cell level for their advanced molecular and biochemical courses. This improved course retains the study of basic tissue types, organ system histology, and the completion of a project. To make room for these proposed newer cell biology/histology techniques, a careful culling of prepared slides was required. Previously, the Histology course provided a large number of students with the impetus to pursue independent study projects. By expanding the exposure of more students to a wider variety of techniques, this program stimulates even greater interest in pursuing Cell Biology- or Histology-related projects.

The grantee institution is matching the NSF awarded with an equal sum obtained from non-Federal sources.

|                |             |
|----------------|-------------|
| Joyce M. Cuff  | USE 8851777 |
| Thiel College  | \$7,387     |
| Greenville, PA | Biology     |

#### **"Molecular Physiology Equipment for Undergraduate Laboratories and Independent Study"**

Seven courses in the Biology curriculum have been targeted for inclusion of a molecular physiology component, both because of the role played by Molecular Physiology in modern Biology, and because these seven courses in-

volve both majors and non-majors at all levels of undergraduate education. Two spectrophotometers with flowcell, thermoelectric cell, and recorder interface, and one strip chart recorder now are enabling students (a) to perform experiments in enzyme and transport kinetics, (b) to conduct a variety of metabolic studies, and (c) to pursue aspects of molecular physiology in their independent research projects.

These experiences better inform undergraduate students about contemporary Biology and better prepare majors for advanced studies, teaching careers, and professional work.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

|                      |             |
|----------------------|-------------|
| Gilbert W. Fairbanks | USE 8853268 |
| John D. Batson       | \$41,255    |
| Furman University    | Biology     |
| Greenville, SC.      |             |

#### **"Instrumentation to Support Interdisciplinary Undergraduate Studies in Neurobiology"**

With help from the instruments obtained through this project, the Biology and Psychology Departments are increasing their interdisciplinary approach to neurobiological studies. The two departments already share labs and animal room facilities and cross-fertilize one another's laboratory exercises in Physiological Psychology and Histology. In the latter case, lesioned rat brains are microscopically examined in the Histology lab. The present project is fostering the further development of this type of cooperation.

With a new Biology faculty member who is acquainted with fluorescent microscopy, studies of brain neurotransmitters are being incorporated into several courses. With new computer-interfaced instrumentation, the Psychology Department is able to improve undergraduates' laboratory work in Electrophysiology. Through the sharing of this equipment, techniques perfected in the Psychology Department have become available to students in Physiology courses. Additional instruments enable the Psychology Department to include in its laboratory program some EEG and biofeedback studies, while enabling the Biology Department to update the performance level and reliability of its physiological monitoring equipment. The requested equipment also enhances undergraduate research projects already boosted by a highly effective DANA Foundation program which financially supports undergraduates doing summer research.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

|                   |             |
|-------------------|-------------|
| Laura K. Thompson | USE 8851898 |
| Furman University | \$22,604    |
| Greenville, SC    | Biology     |

#### **"Equipment for a Modern Undergraduate Molecular Genetics Laboratory"**

This department is using the present award to procure the equipment needed for teaching of modern nucleic acid research, providing students an opportunity to explore such modern research techniques as recombinant DNA technology and protein analysis. DNA electrophoresis and protein gel electrophoresis units along with such supportive equipment needed in work with recombinant DNA as a micro-centrifuge, micropipetters, a UV transilluminator, speed vac, vacuum oven, shaker incubator, sonicator, and cold cabinet are being used by students in a new course, Molecular Genetics, as well as in two already established core courses.

Students learn protein chemistry, DNA structure, RNA expression, and other protocols used in recombinant DNA technology. In a five-year period about 250 undergraduates involved in an average of three to four courses per student will have extensive hands-on experience with this equipment.

This project is one result of the university's positive steps toward providing its students with classes in the rapidly expanding field of genetic engineering and recombinant DNA technology. A biology faculty member with expertise in these fields, hired in 1987, is designing the new Molecular Genetics course.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

|                     |             |
|---------------------|-------------|
| Susan M. Libes      | USE 8852385 |
| Univ South Carolina | \$20,767    |
| Conway, SC          | Biology     |

#### **"Undergraduate Equipment for Applying Qualitative and Quantitative Analysis to Environmental Monitoring"**

This Marine Science Department recently developed an area of emphasis in Marine Analytical Technology (MAT), the aim of which is to produce environmental technicians. Particular emphasis has been given to acquisition of organizational and analytical skills needed to monitor environmental quality and to assess the impacts of pollutants. This grant provides funds to purchase equipment needed to measure a variety of federally-recognized Priority One Pollutants using methods approved by the Environmental Protection Agency. The equipment required is a gas chromatograph for pesticide, PCB and PAH analysis, a graphite furnace for heavy metal analysis, and a silica cell for petroleum-hydrocarbon fingerprinting. The latter two pieces of



equipment are accessories to equipment already on hand, i.e. an atomic absorption spectrophotometer and an infrared spectrophotometer, respectively. The machines will be used in laboratory courses required in the MAT program, as well as in elective courses and in undergraduate independent research projects.

The increasing amounts of environmental management being conducted in this country and worldwide assure a large ongoing demand for well trained environmental technicians. Thus this project is significant in that it supports a program expressly designed to teach students highly marketable science/technology-based skills that can be acquired during the undergraduate years.

The grantee institution is matching the NSF award with a slightly greater sum obtained from non-Federal sources.

Leland G. Johnson  
Augustana College  
Sioux Falls, SD

USE 8851188  
\$19,400  
Biology

#### **"Oxygen and Carbon Dioxide Analysis Systems to Enhance Laboratory Exercises in Whole Organism Biology"**

The aim of this project is to provide undergraduates new experiences in applying state-of-the-art, computer-interfaced instruments to the study of whole organisms. It permits them to implement metabolic studies at several levels in the Biology curriculum through the acquisition and utilization of two Ametek S-3A/II oxygen analyzers, the upgrade of the Li-Cor CO<sub>2</sub> analyzer to the standard of Li-Cor 6250, and acquisition of appropriate computer and interfacing equipment.

The Ametek oxygen analyzers are being applied to laboratory exercises on metabolism in freshman Biology and in three upper division courses. Several of these laboratory exercises examine temperature effects on biological processes. Both instruments and the computer-interfacing capabilities also enrich independent study and research participation programs which are viewed as essential for a strong department. The project is significant because it enhances quantitative and experimental experiences at the organismic level in this department, at a time when improvements recently have been made in instrumentation and methodology for ecological studies and for cellular and biotechnological studies. Students at several levels of educational development now have access to quality systems for studies of organismic gas exchange in highly experimental settings in which instruments are computer controlled and data are reduced and analyzed on-line.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Larry L. Tieszen  
Augustana College  
Sioux Falls, SD

USE 8851442  
\$39,215  
Biology

#### **"Isotope Ratio Mass Spectrometry in the Undergraduate Biology Curriculum"**

The goal of this project is to upgrade the department's Isotope Ratio Mass Spectrometer (IRMS) because this instrument has become a central instructional tool in several advanced courses and is now essential for the independent study/research participation programs mentored by three faculty members. The instrument allows students to study ecological, physiological and biochemical phenomena with a modern approach utilizing natural abundances of the stable isotopes of carbon (<sup>13</sup>C) and nitrogen (<sup>15</sup>N) as quantitative tracers. The upgrade automates sample analyses and facilitates throughput by students, adds a third detector to facilitate isotopic corrections, allows nitrogen analyses to be undertaken readily, and utilizes a computer-controlled analytical system which transmits data to a departmental network for reduction, statistical analyses, and presentation. The instrument is being supported by an IRMS technician who facilitates student training and use. The upgrade is significant because it extends the instrument into the hands of more students in advanced courses and enhances student-mentor opportunities.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Michael T. Griffin  
Bee County College  
Beeville, TX

USE 8851662  
\$12,993  
Biology

#### **"Equipment for an Undergraduate Microbiology Laboratory"**

This project is providing a modern, safe steam autoclave for the sterilization of culture media and supplies used in the teaching of Microbiology to undergraduates, most of whom are Hispanic women. The acquisition of a new modern steam autoclave provides the department with a more efficient and reliable means of preparing bacteriological culture media. This improvement benefits the students enrolled in Microbiology courses by providing them with the required materials for instruction in the culture and identification of microorganisms.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.



Donn D. Martin  
Texas Wesleyan College  
Fort Worth, TX

USE 8853346  
\$28,220  
Biology

#### **"Computer-Interfaced Physiological Equipment for Undergraduate Instruction"**

The objectives of this project are to give students experience with state-of-the-art analytical equipment, and to increase their familiarity with Quantitative Biology. To address these issues, this department is equipping its Physiology Laboratory with four computer-interfaced data acquisition systems with physiological monitors for the measurement of bioelectrical and biomechanical activities. These data acquisition systems, supported by the appropriate software, are capable of data storage, analysis, manipulation, and retrieval. The simulation capabilities of the computer may be exploited also for the visualization of equations used for modeling various physiological processes. Students then may compare the theoretical and actual outputs of each physiological system studied.

Processes to be studied using this equipment include muscle, skin, and nerve activity, cardiovascular physiology, respiration, and glandular secretion. Mastery of this equipment provides the undergraduate with a background for understanding the operation principles of other types of equipment using the sensor/transducer/amplifier/recorder component series. The simulation experience helps students to bridge the conceptual gap between real physiological processes and their mathematical models.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Rosemary Hubbard  
Marymount College of Virginia  
Arlington, VA

USE 8852723  
\$11,407  
Biology

#### **"Computer-Interfaced Physiology Equipment for an Undergraduate Teaching Laboratory"**

This project is part of an overall plan to improve laboratory instruction in the Biological Sciences through the introduction of modern computer-interfaced equipment. The plan develops the following areas: (1) the introduction of more quantitative physiological experiments, (2) the improvement of instruction involving computers, (3) the application of the computer to data gathering and analysis and to simulating scientific phenomena, and (4) the introduction of student research. The course which accrues the greatest benefit from these developments is Anatomy and Physiology. However, the equipment requested is being utilized in all Biology courses where appropriate.

Because this college enrolls women primarily and because these women in science pursue careers in medicine, teaching, nursing and research, the main benefit of these

modern instruments is to provide women with stronger qualifications for continuing graduate studies or for entering science-based careers.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Joanne Rosinski  
Sweet Briar College  
Sweet Briar, VA

USE 8852144  
\$8,400  
Biology

#### **"Equipment for Undergraduate Plant Cell and Tissue Culture Laboratories"**

With equipment procured through this project, new laboratory exercises using plant cell and tissue culture are being introduced into courses in Botany and Cell Biology. These exercises expose students to an important area of the plant sciences which currently is making significant contributions to the field of Biotechnology. Students use techniques such as phase and fluorescence microscopy to follow the stages of development as isolated, individual plant cells are induced to produce new tissue, and eventually to give rise to whole new plants. This process vividly demonstrates to students the excitement of working with plant systems and stimulates interest in further work in the plant sciences—an area into which additional women need to be recruited.

The project holds promise for developing into a model that could be adopted widely in other institutions.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Peter G. Pauw  
Gonzaga University  
Spokane, WA

USE 8851591  
\$26,065  
Biology

#### **"Studies for an Advanced Undergraduate Genetics Curriculum"**

The purpose of this project is to develop a modern Advanced Genetics curriculum. The course developments being funded include laboratory courses in Somatic Cell Genetics and Microbial Genetics. These courses teach concepts and techniques of modern genetic approaches to answering questions about biological structure and function.

Specifically, course development is employing new equipment for the culture, observation and storage of animal cells, including CO<sub>2</sub>-regulated incubators, biological containment hoods, inverted phase-contrast microscopes, and cryogenic freezers. In addition, gel electrophoresis apparatus and other equipment are being acquired for the biochemical analysis of alterations in gene expression that can be detected in cell culture and microbial models.

In addition to these specific course developments, the equipment permits a greater involvement of undergraduates in meaningful individual directed-research projects.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Donald F. Calbreath  
Whitworth College  
Spokane, WA

USE 8851287  
\$9,400  
Biology

#### **"Equipment to Improve Undergraduate Course Work and Independent Study in Biochemistry"**

This project involves acquisition of a refrigerated centrifuge for use in the undergraduate Biochemistry program. The centrifuge permits the preparation of materials for a wide variety of experiments that illustrate basic biochemical techniques used in laboratories associated with regular coursework. This acquisition also opens to undergraduates an array of additional independent research projects in Biochemistry, providing valuable preparation for the large percentage of students from this department who pursue professional education beyond the Baccalaureate.

These increased opportunities, while not novel, fill a gap in the previous Biochemistry Laboratory program, strengthening it in significant ways.

The grantee institution is matching the NSF award with a slightly greater sum obtained from non-Federal sources.

Alfred B. Ordman  
Beloit College  
Beloit, WI

USE 8851464  
\$78,097  
Biology

#### **"Equipment for an Undergraduate Biotechnology Laboratory Program"**

Integrated biotechnology and computer laboratories for the Biochemistry program will be set up to train Biology, Biochemistry, Chemistry and other majors in recombinant DNA and monoclonal antibody production and scale-up methods. Because these methods have become basic to many areas of science, students should develop these skills as undergraduates for use in required internships and their own research.

The number of Biochemistry majors in this department has steadily increased over the past seven years; 80% of them going on to medical or graduate schools.

DNA electrophoresis and blotting equipment, an inverted microscope, an ultracold freezer, a preparative centrifuge, a fermenter and two spectrophotometers permit DNA restriction mapping, cloning, and the production of proteins and monoclonal antibodies. A Biology Computing Center is being established where faculty developed soft-

ware allows students to gain experience with experimental design, data collection and analysis, in addition to their lab experience. Two innovative features of this project are 1) the integration of the hands-on labs with computer simulations, allowing for practical lab experience with realistic experimental design and data analysis in a short period at low cost, and 2) the way in which labs prepare students for internships and research where people cooperate on long-term projects that integrate several methods.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Kent C. Clinger  
Bethany College  
Bethany, WV

USE 8852446  
\$5,257  
Biology

#### **"Introducing Scintillation Counting into the Undergraduate Biochemistry Curriculum"**

The liquid scintillation counter purchased through this project is making it possible to introduce the theory and techniques of scintillation counting into the undergraduate Biochemistry curriculum. The new machine is used to teach undergraduates how to count radioactive isotopes commonly found in industrial, medical, and academic laboratories. The instrument will be used also to study the transport of amino acids across biological membranes, to determine amounts of protein synthesis, and to find the rate at which two strands of DNA combining to form double stranded DNA interact. This instrument also will be used in a variety of undergraduate biological and chemical research projects.

This project will better prepare Biochemistry, Chemistry, and Biology students for success as scientists and medical professionals, and for their service to society.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Betty F. Thacker  
Wheeling College  
Wheeling, WV

USE 8852741  
\$23,600  
Biology

#### **"Improving Data Acquisition and Analysis in the Undergraduate Biology Curriculum"**

This Department is purchasing equipment to enhance the development of data acquisition and analysis skills in undergraduate students—both majors and non-majors. Computer simulations and interactive videos are creating an environment in which non-major students can collect and evaluate data without being dependent on manual skills. This enables even scientifically naive students to become involved quickly in scientific pursuits and to begin to ex-

perience ways in which scientists solve problems. In upper level courses (including research projects) majors have opportunities to work with computer-interfaced instruments to speed data collection and to accomplish calculations that enable the student to interpret and draw conclusions from related groups of facts. The thrust of the

project is to spend more time thinking about the implications of data sets than is spent in acquiring the factual information.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

## CHEMISTRY

Janice B. Woodall  
Southern Union State  
Wadley, AL

USE 8852299  
\$21,022  
Chemistry

### **"Modernization of Instrument-Based Chemical Laboratory Education"**

The quality of chemistry course offerings is being improved both in terms of coverage as well as in facilities and equipment. Accordingly, a complete renovation and reassessment is being made to upgrade and improve the general and organic chemistry courses currently offered with special emphasis on instrumentation. The PI is spearheading the major improvement plan. The major equipment being added to the basic general and organic chemistry laboratories includes a computer and accessories, a student model gas chromatograph, an infrared spectrophotometer, balances, pH meters, a polarimeter, a Spectronic 20 as well as other minor items. The introductory and organic lecture sequence is also being totally revised to reflect the availability of the new equipment.

The grantee is matching the award from non-Federal sources.

Jerald M. Manion  
Univ of Central Arkansas  
Conway, AR

USE 8851649  
\$34,100  
Chemistry

### **"Upgrading of Spectroscopic Techniques in the Undergraduate Curriculum"**

The undergraduate instruction for chemistry majors is being upgraded and the curriculum modified. The new curriculum includes introducing new laboratory courses in the instruction of advanced theoretical topics and laboratory techniques within the department. The two laboratory courses are making extensive use of NMR spectroscopy; one is an intermediate level course in Organic Spectroscopy and the other is a senior laboratory for chemistry majors. In addition, the department is adding experiments utilizing variable temperature NMR and decoupling in these and other courses within the curriculum. The department purchased a Varian EM360L Nuclear Mag-

netic Resonance Spectrometer equipped with an EM3630 Decoupling Accessory and an EM3640 Variable Temperature Accessory for use in accomplishing these goals.

The grantee is matching the award from non-Federal sources.

Danny White  
American River College  
Sacramento, CA

USE 8851710  
\$38,464  
Chemistry

### **"Computer-Directed Experiments for Freshman Chemistry Laboratories"**

Freshman chemistry students are being prepared for transfer to four year institutions and for careers in industry by doing laboratory experiments using computer-directed equipment. This is happening by upgrading Chemnet (Chemistry CAI) with more powerful computers and printers that have more capabilities and chemical applications for handling and manipulating data. The freshman students are learning to store data on text files, carry the text files to Chemnet, and transfer the files into Chemnet for data evaluation, printing and plotting. Students are also using a computer to control the variables of the experiment and the UV-Visible spectrophotometer and then transfer the data electronically with Chemnet. The students are also using the computers with other accessories to learn additional laboratory techniques.

The grantee is matching the award from non-Federal funds.

Ray M. Ward  
Bakersfield College  
Bakersfield, CA

USE 8852544  
\$12,380  
Chemistry

### **"Improvement of Spectrophotometric Experiments in General and Organic Chemistry"**

The number of available Spectronic 20 spectrophotometers in General Chemistry is being increased from two to twelve units. This is allowing all students in a full lab-



oratory section to perform experiments requiring extensive measurements from these instruments. The new instruments are allowing the curriculum to include experiments which establish the formula of complexions, rates of dissociation of complexes, kinetic rate laws for the bromination of acetone, and other appropriate quantitative experiments. A second infrared spectrophotometer is also being added. This is allowing the organic laboratory students to increase their routine analysis of starting materials and synthesis products. It is also facilitating the introduction of infrared analysis into the general chemistry laboratory sections which are currently too large to be served by a single instrument. An example of a new experiment, which has been added is a study of the bonding in ligands of a cobalt (III) complex.

The grantee is matching the award from non-Federal sources.

Gerald R. Van Hecke  
Harvey Mudd College  
Claremont, CA

USE 8851387  
\$53,217  
Chemistry

#### **"A Multi-Functional Laser Laboratory for Undergraduate Chemistry"**

A central multi-functional laser laboratory is being created. The laboratory is allowing the unique capabilities of laser light sources and computer-assisted data acquisition and analysis to be realized by undergraduate students. The facility is providing the means to augment the teaching of classical thermodynamics, integrating the teaching of molecular spectroscopy across three years of study and providing an opportunity for experimentation in kinetic studies. Specifically the laboratory consists of two laser light sources (an argon laser and a nitrogen-pumped dye laser), associated optics, a monochromator, sample holders, a detection system, and a microcomputer for experiment control and data analysis. The equipment is mounted on a common optical table to allow for the modular design of experiments which share a common source or detector, providing an economy of scale. The system allows novel measurements of physical and chemical properties in ways which more clearly elucidate these properties as well as illustrate the power of modern optical techniques. In addition, students' experience with computer control and interfacing is being significantly enhanced. It is planned to describe the successful projects in the literature to provide impact beyond the local facility.

The grantee is matching the award from non-Federal sources.

C. David West  
Occidental College  
Los Angeles, CA

USE 8851689  
\$31,228  
Chemistry

#### **"GC-MS for Undergraduates"**

A Gas Chromatograph-Mass Spectrometer is being added to the undergraduate laboratories. The instrument is being used in the analytical laboratories to separate and analyze for priority pollutants, drugs, and other chemicals of environmental and social concern; in the organic laboratory, to enable complete characterization of an unknown and the target molecule in a synthetic project; and in the inorganic laboratory, to separate and analyze organometallic compounds synthesized in the laboratory, such as tris (acetylacetonate manganese (III)). In the physical chemistry laboratory, it is being used to verify mechanisms via a kinetic isotope effect, as in the iodination of acetone. A significant number of students do research both during the academic year and during the summer. The students doing undergraduate research are finding the GC-MS indispensable in their work.

The grantee is matching the award from non-Federal sources.

Jack D. Cummins  
Metropolitan State College  
Denver, CO

USE 8851884  
\$36,373  
Chemistry

#### **"Utilization of Gas Chromatograph/Mass Spectroscopy by Undergraduates"**

A Hewlett Packard Gas Chromatograph/Mass Spectrometer is being purchased for the use in five areas of Chemistry. By teaching the principles and operation of a modern microprocessor driven separation and identification technique, students are learning chemical principles as well as data techniques. Specific experiments have been designed in the classical chemistry areas. For example, the analysis of branched fatty acids of the human skin surface is being considered in Biochemistry. In instrumental analysis the detection of zeranone and zearalenone, used as the fattening agent, in cattle is being used to acquaint the students with some practical approaches to GC/MS. The department also teaches a course in Criminalistics and the use of GC/MS is being used to illustrate the wide applicability of the technique in this area.

The grantee is matching the award from non-Federal sources.



Bhal C. Barot  
Otero Junior College  
La Junta, CO

USE 8852025  
\$5,000  
Chemistry

Steven Radak  
Miami-Dade Community College  
Miami, FL

USE 8852871  
\$11,500  
Chemistry

#### **"Infrared Spectrophotometer for the Organic Chemistry Laboratory"**

The infrared spectrophotometer is being used in the one-year Organic Laboratory course and for demonstration purposes in the General Chemistry and Introductory Chemistry courses. The instrument is being used in the Organic Laboratory for regular experiments, such as qualitative analysis for functional groups, and is improving the students learning efficiency as well as the department's instructional capability. Students are also doing special projects such as a kinetic and mechanism study and structural analysis of the products of oxidation reactions of various alcohols using a variety of oxidizing agents.

The grantee is matching the award from non-Federal sources.

Reggie L. Hudson  
Eckerd College  
Saint Petersburg, FL

USE 8851650  
\$10,000  
Chemistry

#### **"Introduction of Fourier Transform Infrared Spectroscopy into the Chemistry Curriculum"**

Fourier Transform Infrared Spectroscopy is being introduced into the chemistry curriculum. The project centers on a modern FTIR spectrometer, FTIR accessories, and a dedicated microcomputer. The equipment is being used with old experiments as well as with new ones designed to illustrate modern infrared spectroscopy. Students from the introductory laboratory courses to the advanced, integrated laboratory courses and thesis research projects are using the FTIR instrument. It is likely that it will become the chemistry department's most heavily used spectrometer, replacing three unreliable vacuum-tube instruments. With the FTIR, students are able to characterize unknowns and synthesized materials faster and with greater confidence. Studies of "real world" samples are being facilitated as well as the investigation of reaction rates and molecular structure. Since FTIR methods are finding increased use in government, industrial and academic laboratories, students are better prepared to enter the workforce, graduate schools, and professional schools because of this project.

The grantee is matching the award from non-Federal sources.

#### **"Curriculum Development of Laboratory Courses through Atomic Absorption Spectrophotometry"**

The community college offers the first two years of science and engineering curriculum heavily relying on traditional methods of analysis and theory. Most modern laboratories rely on sophisticated instrumental analysis. Therefore with the acquisition of an Atomic Absorption Spectrophotometer, the students are being better equipped to enter their junior year in a senior institution with skills that are demanded for proficiency in their career. This project is providing lower level students access to the actual "hands on" instrumental analysis and solution preparation. In addition they are gaining experience in the assessment of the quality of laboratory generated data which will assist with developing problem solving skills required in any life situation.

The grantee is matching the award from non-federal funds.

Richard Schwartz  
Santa Fe Community College  
Gainesville, FL

USE 8852354  
\$26,411  
Chemistry

#### **"Improvement of the General Chemistry Curriculum Through Simulations and Modern Equipment"**

The curriculum is being enhanced by the establishment of a dedicated microcomputer laboratory component to supplement and expand the present laboratory exercises taught in the chemistry courses. Twenty computers, two printers, two plotters and the requisite software are being purchased. The equipment is being used to reinforce experiments; to familiarize students with modern analytical techniques by using computer simulations, particularly in areas where expensive instrumentation is not available; and to provide numerous samples for examination and analysis to supplement experiences in the laboratory. The additional laboratory training is helping students gain further knowledge and experience necessary for successful entry and completion of upper division curriculum. Students are also increasing their competency and familiarity with computers, a basic tool of modern science and industry.

The grantee is matching the award from non-Federal sources.

Grace Chiu  
University of West Florida  
Pensacola, FL

USE 8851668  
\$21,418  
Chemistry

#### **"Thermal Analysis Equipment for Undergraduate Laboratory Instruction in Chemistry"**

A new laboratory course in Polymer Chemistry is being introduced with the acquisition of a thermal analysis system for differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA). The equipment is also being used in five undergraduate courses covering analytical, inorganic, organic, and physical chemistry. The equipment is being utilized to expand the offerings in undergraduate research. Sophomore, junior, and senior students are studying the properties, structure, and reactions of a variety of compounds using thermal analysis as a probe. The thermal analysis instrumentation provides a dual benefit in improving the course offerings and updating the instrument holdings to enable the characterization of polymers. Instruction in polymer chemistry in the undergraduate curriculum has been neglected in many institutions. With the thermal analysis system with DSC and TGA capabilities, new experiments can be introduced throughout the curriculum meeting the recommendations of the Committee on Professional Training of the American Chemical Society in this important area.

The grantee is matching the award from non-Federal sources.

Elizabeth Bottomley  
Agnes Scott College  
Decatur, GA

USE 8852283  
\$16,132  
Chemistry

#### **"Improvements in Molecular Emission Experimentation at the Undergraduate Level"**

The students' basic understanding of molecular emission phenomena and the measurement applications which contribute to knowledge of excited states and energy transitions is being improved. Through the use of a computer-controlled luminescence spectrophotometer and a stopped-flow accessory, new experiments are being incorporated in organic, biochemistry, and physical/analytical laboratories for both majors and non-majors. Students in lower and upper division courses are having an enhanced experience with fundamental principles of excitation-emission, chemiluminescence, intermolecular energy transfer, excited-state lifetimes, and analytical applications of luminescence in elucidating biochemical reactions. The undergraduate research program is also being facilitated, as well as a secondary school chemistry teacher's Staff Development Program under the auspices of a grant from the State of Georgia Department of Education. The entire project is promoting a significant advance in unifying concepts related to structure and energy transitions.

The grantee is matching the award from non-Federal sources.

G. William Donaldson  
Emanuel County Junior College  
Swainsboro, GA

USE 8852380  
\$9,478  
Chemistry

#### **"Enhancing Freshman Chemistry"**

The instruction in General Chemistry is being improved by using technology which permits interaction by the students. An integrated system consisting of two computers connected to laser disc players with special touch sensitive monitors have been added to the chemistry instructional program. The technology is providing remedial instruction for the marginal students, supplemental instruction for the better students, and laboratory simulations for all of the students. As a result, students are having experiences that were not previously possible.

The grantee is matching the award from non-Federal sources.

Gladys S. Bayse  
Spelman College  
Atlanta, GA

USE 8853335  
\$8,149  
Chemistry

#### **"Instrumental Analysis and Data Analysis, an Honors Chemistry Course"**

The project is providing instruments and microcomputers to support a senior-level Honors Chemistry course, Instrumental Methods and Data Analysis. The course is placing heavy emphasis on data acquisition and handling using computer-interfaced instruments and selected software packages on microcomputers. Students are then able to evaluate the reliability of collected data and subsequent calculations from their experimental results on several classical instrumentation projects. Undergraduate research efforts are also being enhanced by this project.

The grantee is matching the award from non-Federal sources.

Lavoir Banks  
Elgin Community College  
Elgin, IL

USE 8852175  
\$39,964  
Chemistry

#### **"Equipment to Enhance the Undergraduate Chemistry Program at a Community College"**

A gas chromatograph-mass spectrometer system (GC-MS), a Fourier transform-infrared spectrometer and two high performance liquid chromatographs are being acquired for

the Science Resource Center to help strengthen the Chemistry laboratory program. Acquisition of these instruments is enabling students enrolled in an Associate in Applied Science in Chemical Technology degree program to have access to these instruments which are widely used in industry; allowing industrial technicians to upgrade their skills; and allowing chemistry and other science and engineering students to use state-of-the-art equipment to develop laboratory skills, as well as reinforce the learning of chemical principles. High school advanced placement students, students preparing to be teachers and precollege science teachers are also benefitting by having access to the instruments. In the program, laboratory experiments are being emphasized, utilizing the requested instruments which bridge theoretical concepts with practical industrial applications.

The grantee is matching the award from non-Federal sources.

|                  |             |
|------------------|-------------|
| Robert G. Kooser | USE 8851423 |
| Knox College     | \$25,042    |
| Galesburg, IL    | Chemistry   |

#### **"Revision of Junior Year Physical Chemistry Laboratory"**

The project is removing four perceived deficiencies in the Chemistry curriculum. The deficiencies are: 1) lack of student exposure to modern, computerized instrumentation; 2) lack of laboratory courses at an advanced level; 3) lack of any laboratory work in the important area of polymer chemistry; and 4) lack of modern instrumentation to maintain a vigorous undergraduate research program. The grant is allowing the purchase of modern computerized spectroscopic instruments, computers to control them, equipment to introduce polymer chemistry into the curriculum, and a rapid kinetics spectrometer. The instruments are being used to revamp entirely the first term of the junior-level Physical Chemistry laboratory that is taken by all chemistry majors. In addition, the second term of the physical chemistry sequence that features kinetics and spectroscopy is also being substantially changed in order to incorporate the new capabilities into the laboratory. A new course in the chemical applications of magnetic resonance is being added to the curriculum to give students laboratory experience at the advanced level.

The grantee is matching the award from non-Federal sources.

|                  |             |
|------------------|-------------|
| Edward J. Kelly  | USE 8852225 |
| Marian College   | \$5,337     |
| Indianapolis, IN | Chemistry   |

#### **"Expansion of Electrochemistry in the Undergraduate Curriculum"**

The undergraduate Chemistry program is being strengthened by the integration of the use of voltammetry and

coulometry in the curriculum. Seven courses (Organic Chemistry, Qualitative Organic Analysis, Physical Chemistry Lab, Biochemistry, Quantitative Analysis, Instrumental Analysis and Independent Research) are being revised to provide students with the opportunity to put electrochemical principles into practice through "hands-on" experience, both in laboratory projects and in independent research. The use of voltammetry and coulometry is complementing the current Chemistry program in which students are using ultraviolet-visible and infrared spectrophotometers, NMR spectrometers, gas and liquid chromatography. Thus, integration of electrochemistry in the curriculum is assuring that students receive a more complete preparation in instrumental practice.

The grantee is matching the award from non-Federal sources.

|                  |             |
|------------------|-------------|
| Robert C. Larson | USE 8852339 |
| Drake University | \$29,150    |
| Des Moines, IA   | Chemistry   |

#### **"Introduction of a Computer-Controlled Gas Chromatograph/Mass Spectrometer into an Updated Undergraduate Chemistry Program"**

Principles and applications of gas chromatography/mass spectrometry is being introduced into the Chemistry curriculum as one phase of improving chemical education. Through the purchase of a bench top GC/MS complete with computer operating system and software the students are being given the opportunity to gain hands-on experience with this powerful modern analytical technique. The instrumentation is being introduced in analytical and advanced opportunities sequence and carries over into organic, inorganic, physical and biochemistry courses.

The project is fostering within the undergraduates the familiarity, knowledge, and expertise in modern chemical instrumentation required for successful undergraduate research, careers in industry or entry into professional and graduate schools. Through an advanced opportunity program, students are being exposed to the major areas of chemical instrumentation in their freshman and sophomore years. Analytical instrumentation, presently fragmented throughout the curriculum, is being brought together in a unified junior level advanced analytical course. A new emphasis is being brought to undergraduate research within the department.

The grantee is matching the award from non-Federal sources.



Anthony L. Heino  
Luther College  
Decorah, IA

USE 8852154  
\$5,215  
Chemistry

Graham W. Ellis  
Benedictine College  
Atchison, KS

USE 8851628  
\$14,370  
Chemistry

#### **"Enhanced Instruction in Spectrophotometry"**

Improvements and expansion in the teaching of spectrophotometry has been limited by the small number of suitable instruments available in the Chemistry department. Acquisition of the nine spectrophotometers removed this deficiency. The instruments are being used by science students in a number of chemistry courses and by non-science and education students in courses of an interdisciplinary nature. The additional instruments are also permitting more extensive use of spectrophotometry in experiments conducted with area high school students and teachers.

The grantee is matching the award from non-Federal sources.

Ching S. Woo  
University of Northern Iowa  
  
Cedar Falls, IA

USE 8853044  
FY88  
\$11,922  
Chemistry

#### **"Electrochemical Equipment for the Instrumental Analysis Laboratory"**

Electrochemical methods are becoming increasingly important in the studies of Chemical, Biomedical and Environmental Sciences. Laboratory experience is being offered in the principles and techniques of contemporary electroanalytical methods to Chemistry majors and other science students enrolled in instrumental analysis courses. The BAS 100A electrochemical analyzer capable of performing a wide variety of controlled potential techniques and computer data handling is being utilized in inorganic and organic trace analyses, kinetics and mechanism studies. The voltammetric techniques are being taught via an integrated electrochemistry workstation in a simple, rational and stimulating manner. Students who are generally more familiar with spectrochemistry and chromatography are also using electrochemical techniques to equal advantage in solving analytical problems in their independent projects and undergraduate research. In addition, students in an Environmental Chemistry course are applying the electrochemical techniques to investigate "speciation" of metals and anions in electrochemical samples.

The grantee is matching the award from non-Federal sources.

#### **"Integration of Modern Chromatographic Instrumentation into the Undergraduate Chemistry Curriculum"**

A Gas Chromatograph (GC) and High-Pressure Liquid Chromatograph (HPLC) are improving laboratory instruction in Analytical Chemistry, Biochemistry, Organic Chemistry, Physical Chemistry, Chemistry for Non-Science Majors, General Chemistry and Advanced Laboratory Courses as well as Undergraduate Research. The acquisition of GC and HPLC instruments is enhancing student understanding of a) the fundamentals of chromatographic science; b) the utilization of GC and HPLC for qualitative and quantitative analysis of chemical systems; c) the utilization of GC and HPLC for investigating reaction mechanisms; and d) the utilization of GC and HPLC for separation and purification of chemical compounds.

As GC and HPLC instruments are found in most governmental, industrial and academic laboratories, the introduction of these instruments into the undergraduate chemistry program is better preparing the students for future employment in the chemical profession. Also the use of GC and HPLC instruments in introductory courses for non-science majors is acquainting these students with the use of one of the major principles and methods in chemistry.

The grantee is matching the award from non-Federal sources.

Norma Steinman  
Neosho County Community College  
Chanute, KS

USE 8852226  
\$7,640  
Chemistry

#### **"Atomic Absorption in a Cooperative Project with Local Industry"**

This community college is acquiring an Atomic Absorption Spectrometer for use in Beginning Chemistry as well as in Continuing Education. Local industrial firms are supplying samples that can be used for analysis giving the students an opportunity to learn chemistry on items with which they are particularly familiar. One manufacturing plant is a circuit board plating plant and does extensive metal analysis, and the other is involved in working with a Vermiculite used in animal feed. Both provide opportunities for interesting student involvement and a challenging opportunity for the students.

The grantee is matching the award from non-Federal sources.

Darwin B. Dahl  
Western Kentucky University  
Bowling Green, KY

USE 8852664  
\$15,669  
Chemistry

#### **"Acquisition of Spectrophotometric and Computer Interfacing Systems"**

The grantee is seeking to improve the sophomore and junior level Chemistry laboratories. The development and implementation of modern experiments into the quantitative analysis laboratory is of immediate concern. To effectively grasp new methods and techniques used in the industry's increasingly computerized laboratories, it is necessary for the student to have "hands on" experience with computer-controlled instrumentation. Specifically a scanning uv-visible spectrophotometer and a fluorescence spectrophotometer, both interfaced to computers, are being added to expand the current level of experiments and data handling capabilities. In addition, an introduction to the interfacing of simple equipment such as pH meters and temperature probing devices is available to the student as a result of the computer's versatility.

The grantee is matching the award from non-Federal sources.

James D. Goodrich  
Louisiana State University  
Shreveport, LA

USE 8851427  
\$14,242  
Chemistry

#### **"Improved Chemistry Instruction with UV-Visible Spectrophotometry"**

The acquisition of nine spectrophotometers is providing modern, reliable instruments for first- through fourth-year Chemistry Laboratories. New and revised experiments using spectrophotometric techniques are being introduced at all levels. First year Chemistry Laboratory students are utilizing four spectrophotometers interfaced to microcomputers to acquire data from three experiments to quantify a chemical equilibrium constant, the percentage of manganese in steel, and a kinetics rate law expression. Non-science curricula students in another laboratory course are spectrophotometrically determining the iron content of some common foods. Students in second year quantitative analysis are using four microprocessor controlled spectrophotometers also linked to a microcomputer to determine two metals in mixtures and phosphorous in blood serum. The students are also isolating and identifying lycopene and beta-carotene from tomatoes by using a scanning ultraviolet-visible spectrometer. Students in organic chemistry are being introduced to scanning uv-visible spectrophotometry in a study of the isomerization of an alkene. Upper-division Chemistry curriculum students are using the same scanning uv-visible spectrophotometer to determine ligand field characteristics, stability constants, and

identify compounds. The grantee is matching the award from non-Federal sources.

James G. Boyles  
Bates College  
Lewiston, ME

USE 8851648  
\$10,576  
Chemistry

#### **"Computer Interfacing for Laboratory Data Acquisition and Analysis"**

The questions being asked by today's scientists are moving them steadily into realms where rapid acquisition of data is commonplace, and where sophisticated and detailed analysis is required to make these data sensible. Exposure to the uses and applications of the tools required to engage in this work is becoming an increasing necessity in the undergraduate preparation of young scientists. The microcomputer with its potential for interfacing to instruments and apparatus is a central tool in this process. It is the aim of this project to provide, for Chemistry majors, meaningful instruction in and experience with computer interfacing in laboratory environments. Six computer interfacing units are being purchased to be used in six different laboratory courses distributed over the last three undergraduate years. The project is providing an early introduction to computer interfacing, with units appropriately configured for use by inexperienced students. Uses and applications are building in sophistication as students move into more advanced laboratory situations. Chemistry majors are engaging in multiple experiences with these tools and techniques, and it is estimated that seventy new students per year are being exposed to the techniques.

The grantee is matching the award from non-Federal sources.

Darcy Williams  
Cecil Community College  
North East, MD

USE 8852474  
\$32,127  
Chemistry

#### **"Instrumentation for a Two-Year Chemistry Laboratory Technician Program"**

The primary aim of the project is to improve the quality of a new and innovative Chemistry Laboratory Technician Program through the acquisition of a UV-Visible Diode Array Spectrometer, Gas Chromatograph, Liquid Chromatograph, Refractometer, and pH meters, as well as computer interfacing equipment. The instruments are also being used in Chemistry courses taught to students who intend to transfer to four-year colleges.

Due to the working partnership created between the college and the chemical industry in developing and running the program, both are sharing the responsibility for

contributing and/or purchasing equipment as a match to the project.

The grantee is matching the award from non-Federal sources.

|                               |             |
|-------------------------------|-------------|
| Allan K. Hovland              | USE 8852439 |
| St Mary's College of Maryland | \$34,837    |
| Saint Mary's City, MD         | Chemistry   |

#### **"Enhancing Instruction with NMR Spectrometry"**

A Varian EM-360L Nuclear Magnetic Resonance Spectrometer equipped with a variable temperature probe and lock/spin decoupler is enabling the College to achieve a major curricular goal in its Chemistry program. The opportunity for students to gain hands-on experience with instrumentation that plays a fundamental role in the modern chemistry laboratory is being achieved. The NMR is being incorporated into laboratory work in Organic, Physical, and Inorganic Chemistry courses. Laboratories are being enhanced with more rigorous and instructionally richer experiments. Student research quality is being markedly improved with the improved quality of the data and the unique information the instrument provides.

The grantee is matching the award from non-Federal sources.

|                         |             |
|-------------------------|-------------|
| Joseph J. Topping       | USE 8852251 |
| Towson State University | \$22,500    |
| Towson, MD              | Chemistry   |

#### **"Improvement of the Undergraduate Analytical Chemistry Curriculum through the Introduction of Atomic Absorption/Flame Emission Spectrophotometry"**

The undergraduate Analytical Chemistry curriculum is being enhanced by incorporating state-of-the-art atomic absorption/flame emission instrumentation into the laboratory courses at the lower level for both majors (Quantitative Analysis) and non-majors (Introduction to Analytical Chemistry). At the same time, this project is facilitating instruction of majors in the upper division courses in instrumental methods and undergraduate research. The spectrophotometer affords a number of capabilities not previously available to students in these courses, for example, flameless atomization, background correction, data storage, editing and reporting, and software control. This is providing a wide variety of student experiences, from fundamental to complex to emphasize both function and application.

The grantee is matching the award from non-Federal sources.

|                           |             |
|---------------------------|-------------|
| Ronald M. Jarret          | USE 8852774 |
| College of the Holy Cross | \$100,000   |
| Worcester, MA             | Chemistry   |

#### **"Improvement of the Chemistry Curriculum Through Fourier Transform—Nuclear Magnetic Resonance Spectroscopy"**

Fourier Transform Nuclear Magnetic Resonance (NMR) spectroscopy is being incorporated into the Chemistry program. Acquisition of the instrument is modernizing the way NMR is taught in the laboratories associated with Physical, Organic, and Analytical Chemistry as well as the course for nonscience majors. In addition, the Instrumental Chemistry and Spectroscopy lecture courses and the student research program are being impacted. The acquisition is consistent with the department's effort to provide state-of-the-art instrumentation for both the year long and summer student research program. On average since 1980, thirty-six chemistry majors (35% women) graduate yearly from the program with 20% going on to graduate school. Since almost all of the undergraduates enroll in research courses and are utilizing the instrument, it is having a positive impact on the continued competence of the Chemistry majors.

The grantee is matching the award from non-Federal sources.

|                   |             |
|-------------------|-------------|
| Ronald M. Pike    | USE 8851510 |
| Merrimack College | \$23,000    |
| North Andover, MA | Chemistry   |

#### **"An Integrated Four Year Spectroscopy Program"**

Fourier Transform Infrared Spectroscopy (FTIR) is being incorporated into an integrated four-year spectroscopy sequence and into professional education programs. The program is impacting the laboratories in General, Organic, Inorganic, Physical, Analytical and Biochemistry, as well as senior research. The addition of FTIR upgraded the instrumental facilities and is allowing the offering of well-balanced, modern laboratory experience.

Many of the changes were initially implemented using a loaned FTIR instrument, which were made permanent by this project enhancing both the academic and professional programs.

The grantee is matching the award from non-Federal sources.

|                   |             |
|-------------------|-------------|
| Zvi Szafran       | USE 8852203 |
| Merrimack College | \$34,937    |
| North Andover, MA | Chemistry   |

#### **"Nuclear Magnetic Resonance Instrumentation for Enhanced Undergraduate Instruction"**

The level of instruction of undergraduate Chemistry is being improved through the acquisition of a Proton Nu-



clear Magnetic Resonance Spectrometer. Existing courses being impacted by this proposal include: Organic Chemistry, Inorganic Chemistry, Physical Chemistry, Chemical Instrumentation, General Chemistry, and Senior Research. In addition two courses for professionals, "Chemical Instrumentation" and "Microscale Qualitative Organic Analysis" are being improved. The instrument is making it possible to integrate the laboratory experience with the lecture material in the areas of structure identification, quantitative analysis, kinetics, and industrial chemistry.

The grantee is matching the NSF award from non-Federal funds.

|                 |             |
|-----------------|-------------|
| James U. Piper  | USE 8853324 |
| Simmons College | \$59,049    |
| Boston, MA      | Chemistry   |

**"Enhancement of the Chemistry Curriculum by Replacement of an Outdated Nuclear Magnetic Resonance Spectrometer with a Fourier Transform Spectrometer"**

A Fourier Transform (FT) instrument is providing students access to a central instrument for chemistry analysis and providing hitherto unavailable laboratory experience with topics now covered in the curriculum including the important techniques of Carbon-13 NMR spectroscopy and Fourier Transform methods. The instrument is also supporting a new Biochemistry Program which is being developed. The instrument purchased is flexible enough to be used with the lower division curriculum, but with specifications which permit it to meet the demands of advanced courses in physical, analytical, organic, and biochemistry. The instrument is also being used to support senior research projects.

The grantee is matching the award from non-Federal sources.

|                    |             |
|--------------------|-------------|
| William F. Coleman | USE 8852245 |
| Wellesley College  | \$24,300    |
| Wellesley, MA      | Chemistry   |

**"Purchase of Fluorescence Spectrometer in Undergraduate Education"**

A Fluorescence Spectrometer and accessories is being used in upper-division teaching and in student research. The instrument is being used in laboratory courses in Inorganic and Analytical Chemistry, and in undergraduate research projects in Inorganic Chemistry, Biochemistry, Physical Chemistry and in joint projects with members of the Biological Sciences Department. In the teaching laboratories experiments have been designed to use fluores-

cence to measure rates of fast reactions and to illustrate the use of fluorescence as an analytical tool. Research uses are in projects dealing with the photophysics of metal complexes, membrane properties of a particular class of cyanobacteria, measurement of crosslinking in membrane research and the equilibration between photosystems I and II in plants.

The grantee is matching the award from non-Federal sources.

|                    |             |
|--------------------|-------------|
| James R. Hutchison | USE 8852717 |
| Alma College       | \$27,711    |
| Alma, MI           | Chemistry   |

**"Computer Interfaced Experiments for General Chemistry and Physical Chemistry Laboratories"**

Computer interfaced experiments are being introduced into the General Chemistry and Physical Chemistry laboratories. Six experiments are being introduced into General Chemistry involving computers interfaced with sensors for the gathering of experimental data. Temperature probes, colorimeter interfaces or pH meter interfaces designed by project SERAPHIM staff are being used. Lotus 1-2-3 and Lotus Measure are serving as templates at the introductory level. Experiments include chemical kinetics; calorimetry and heat of reaction; molecular weight from freezing point depression; computer driven titration to measure equilibrium; gas chromatography; and statistics and error analysis. In Physical Chemistry the students are doing advanced aspects of some of these same experiments as well as using the computers for analysis atomic and molecular orbitals through display of wave functions and the consideration of changes in bond length.

The grantee is matching the award from non-Federal sources.

|                       |             |
|-----------------------|-------------|
| Ronald L. Blankespoor | USE 8851202 |
| Calvin College        | \$65,600    |
| Grand Rapids, MI      | Chemistry   |

**"Integration of Fourier Transform—Nuclear Magnetic Resonance Spectroscopy into an Undergraduate Curriculum"**

A 200 MHz Gemini Fourier Transform Nuclear Magnetic Resonance (FT-NMR) Spectrometer is being integrated into the undergraduate Chemistry curriculum for chemical analysis. Chemistry laboratory instruction is being improved in six regularly offered courses, one interim course, and the undergraduate research program of the department. Students are being introduced to the FT-NMR in the sophomore Organic Chemistry course and receive hands-on

experience with this state-of-the-art, computer-controlled laboratory instrument as juniors and seniors. The high-field NMR technique produces simplified proton NMR spectra allowing for a more thorough interpretation of spectra by the students and thereby enhancing their ability to use NMR in the identification of compounds they have prepared. They are also becoming familiar with Carbon-13 NMR as an important tool for structural elucidation of substances. Computer control of the instrument is allowing for collection, manipulation, and rapid analysis of data including two-dimensional NMR.

The grantee is matching the award from non-Federal sources.

|                             |             |
|-----------------------------|-------------|
| Bob A. Howell               | USE 8852049 |
| Central Michigan University | \$34,850    |
| Mount Pleasant, MI          | Chemistry   |

**"Nuclear Magnetic Resonance (NMR) Spectroscopy in the Undergraduate Curriculum"**

The reestablishment and enhancement of a quality exposure to NMR spectroscopy for chemistry undergraduates is being carried out in this project. Students in Organic Laboratory, Polymer Laboratory and undergraduate research are being trained to meet previously established performance objectives. These include a sound knowledge of methods and instrumentation, hands-on operation of the instrument and the utilization of NMR spectroscopy for structure determination, characterization of dynamic equilibria, determination of optical purity and observation of reaction rates. This training forms an integral part of a successful instructional program designed to adequately prepare students for a career in industry or for graduate research in Chemistry. To enhance this training, major new development of instruction in the Organic Chemistry Laboratory, Physical Chemistry Laboratory and Polymer Science Laboratory are under way.

The grantee is matching the award from non-Federal sources.

|                          |             |
|--------------------------|-------------|
| Kirk P. Manfredi         | USE 8851455 |
| Bemidji State University | \$30,850    |
| Bemidji, MN              | Chemistry   |

**"Improvement to the Undergraduate Laboratory Curriculum"**

The Department of Chemistry is improving and modernizing the undergraduate laboratory curriculum. Specifically, the Department is introducing NMR spectroscopy into the "Project Lab" chemistry courses. "Project Lab" is a unique approach to laboratory instruction which em-

phasizes individual achievement and preparedness in the chemistry laboratory. With the many applications of NMR spectroscopy the Department is implementing NMR experiments in all areas of chemistry. Experiments are being introduced into the undergraduate lab which are unique to the NMR phenomenon. Ultimately the Department would like to publish some of these experiments to assist other undergraduate institutions in fully utilizing their NMR instructional facilities. The specific piece of equipment that is being utilized is a 60 MHz spectrometer equipped with a variable temperature probe.

The grantee is matching the award from non-Federal sources.

|                    |             |
|--------------------|-------------|
| Olaf A. Runquist   | USE 8851429 |
| Hamline University | \$9,705     |
| Saint Paul, MN     | Chemistry   |

**"The Introduction of Fourier Transform—Infrared (FT-IR) Analysis into the Chemistry Curriculum"**

A Perkin-Elmer Model 1640 FT-IR spectrophotometer complete with a diffuse reflectance accessory and a graphics plotter has been acquired. The theory and practice of FT-IR analysis is being incorporated into the introductory organic course as well as five upper division laboratory courses. The instrument is also being used in undergraduate research. Specific course improvements include the enhancement and expansion of IR analysis in organic laboratories, the introduction of FT theory and instrumentation into analytical, as well as the extension of IR analysis to small samples and opaque materials and extensive demonstration of the FT-IR capabilities as both a qualitative and quantitative tool.

The grantee is matching the award from non-Federal services.

|                            |             |
|----------------------------|-------------|
| Kenyon Latham              | USE 8853099 |
| Lakewood Community College | \$6,670     |
| White Bear Lake, MN        | Chemistry   |

**"Instrumentation and Laboratory Improvement in Undergraduate Chemistry"**

The quality of undergraduate instruction in Organic Chemistry and General Chemistry is being improved through the acquisition and upgrading of equipment. Major instruments being added are a gas chromatograph (GC) system, a high-pressure liquid chromatograph (HPLC) system, and Apple IIgs computer system and an interactive microware (IMI) data acquisition system. The instruments are enhancing the implementation of the microscale laboratory program and are complementing each other in analytical

capabilities, increasing student access to modern equipment, familiarizing them with computer acquisition, storage and manipulation of data, and introducing them to HPLC. Chemical instrumentation is being treated as an integral part of the laboratory work, thereby strengthening the quality of the learning. Laboratory activities such as kinetic studies, competitive reactions, and determination of product distribution ratios is allowing students to actually collect data instead of only seeing it in a textbook. The project is significantly impacting the quality of science education for a group of students in a community college that serves not only as a lower division program, but also to educate employees in a 10-mile circle of science-based corporate neighbors.

The grantee is matching the award from non-Federal sources.

|                       |             |
|-----------------------|-------------|
| Michael R. Ross       | USE 8851849 |
| St. John's University | \$48,250    |
| Collegeville, MN      | Chemistry   |

**"Integration of Gas Chromatography/Mass Spectrometry into the Undergraduate Chemistry Curriculum"**

Gas chromatography/mass spectrometry (GC/MS) is being incorporated into the undergraduate Chemistry curriculum at both St. John's University and the College of Saint Benedict. The mass spectrometer is being interfaced with a gas chromatograph which was previously present. The new system is being used to illustrate the principles and techniques of MS or GC/MS in the organic, physical, advanced analytical, and advanced inorganic courses, as well as student research. All of these areas are being expanded and enhanced by the acquisition of the mass spectrometer. Students are gaining a first hand knowledge of the diversity of applications for a GC/MS system.

The grantee is matching the award from non-Federal sources.

|                                |             |
|--------------------------------|-------------|
| Deborah E. Samkoff             | USE 8852907 |
| Brian Groh                     | \$17,803    |
| University of Minnesota Duluth | Chemistry   |
| Duluth, MN.                    |             |

**"Fourier Transform Infrared Spectrometers for Undergraduate Instructional Laboratories"**

Two Fourier Transform Infrared Spectrometers and required sample cell are being purchased for use in undergraduate Organic Chemistry, Physical Chemistry, Structural Chemistry, and Integrated Laboratory courses. The instruments are replacing outdated, failing equipment previously

in use, allowing the conversion of the organic laboratory courses to microscale work, allowing students in the physical chemistry and integrated laboratories to obtain and analyze high-resolution IR data, and allowing students in the Structural Chemistry course to undertake more sophisticated identification problems than were previously feasible.

The grantee is matching the award from non-Federal sources.

|                     |             |
|---------------------|-------------|
| Edward J. Valente   | USE 8851694 |
| Mississippi College | \$10,325    |
| Clinton, MS         | Chemistry   |

**"Fourier Transform Infrared Spectroscopy for a Modern Chemistry Curriculum"**

Consistent with the increasingly instrumental emphasis of laboratories in chemistry, the project is introducing Fourier Transform Infrared Spectroscopy (FT-IR) into the undergraduate curriculum. Now, widely used for chemical analysis in academic chemical research, industry, forensics, and environmental monitoring, FT-IR spectroscopy is significantly improving the quality of the chemistry instrumental practice. Presently available are new, lower-cost yet high resolution instruments for FT-IR spectroscopy, appropriately and efficiently controlled by a microcomputer for data collection, analysis, and presentation.

Incorporation of FT-IR spectroscopy is improving directly three areas of the undergraduate curriculum: Analytical, Organic Chemistry, and Instrumental Analysis; significant additions to the Physical Chemistry laboratory and enhancement of undergraduate research. The instrument is the only Fourier transform spectroscopy instrument and is introducing the students directly to the utility of modern computer assisted time-domain instruments, and is allowing applications through educationally superior experiments.

The grantee is matching the award from non-Federal sources.

|                   |             |
|-------------------|-------------|
| Don E. Gibbs      | USE 8852343 |
| Rockhurst College | \$25,850    |
| Kansas City, MO   | Chemistry   |

**"Integration of Nuclear Magnetic Resonance Spectroscopy Theory and Laboratory Applications in Undergraduate Chemistry Curriculum"**

Nuclear Magnetic Resonance (NMR) spectroscopy is an indispensable source of chemical information. NMR studies provide much of the basis for theoretical concepts of molecular reactivity and architecture that are fundamental in



undergraduate chemical education. Direct experience with NMR techniques helps students appreciate the basis of these concepts. NMR techniques are the most versatile of all modern instrumental methods. Because NMR instruments can be used in so many parts of the undergraduate Chemistry curriculum, students are aided in the important task of integrating what they learn in different courses. Students graduating in Chemistry, whether entering the job market or graduate school, are being significantly improved through the use of the NMR spectrometer. The NMR purchased allows for maximum information output in students' hands without undue diversion of faculty attention from the close individualized relation with students that is the pride of the Department.

The grantee is matching the award from non-Federal sources.

|                                    |             |
|------------------------------------|-------------|
| Leonora G. Rueppel                 | USE 8852082 |
| St Louis Community College Meramec | \$26,350    |
| Kirkwood, MO                       | Chemistry   |

**"Introduction of Nuclear Magnetic Resonance (NMR) Spectroscopy to Undergraduate Laboratories"**

The project is enhancing the course content in undergraduate organic chemistry laboratories by the addition of NMR to the Organic Chemistry laboratory. Implementation of this project involved the purchase of a Varian EM 360L 60 MHz Nuclear Magnetic Resonance Spectrometer (NMR). Students are having direct hands-on experience using this instrument and are acquiring skill in interpreting NMR spectra. After completing an experiment designed to introduce the techniques of NMR, students continue to use NMR in subsequent experiments to verify the structures of the products of synthetic reactions. Students are also using NMR to analyze product ratios in an experiment where a mixture of products is obtained. In addition, extensive use of NMR is being made during a unit on organic qualitative analysis. The addition of NMR to the Organic Chemistry laboratory course is giving students an understanding of this very important analytical technique which is now an essential feature of modern organic chemistry.

The grantee is matching the award from non-Federal sources.

|                |             |
|----------------|-------------|
| David H. Smith | USE 8851378 |
| Doane College  | \$5,880     |
| Crete, NE      | Chemistry   |

**"Modernization of Spectrophotometric Capabilities"**

Upperclassmen in the sciences need to spend both lecture and laboratory time learning how new information is

obtained and how to design and interpret experiments. The laboratory must provide them with experience in as many major techniques as possible, performed with modern instruments. The college is purchasing a modern ultraviolet-visible spectrophotometer with computerized data treatment capabilities. This versatile instrument is being used to perform kinetics and thermodynamics experiments, determine the concentrations of a wide variety of solutions, record spectra, and manipulate the resulting data. The instrument is being used in courses in Instrumental Analysis, Physical Chemistry, Biochemistry, Organic Chemistry, Genetics, and Cell Biology. In each course, students are learning to solve at least one laboratory problem and to use the techniques to solve other problems they will face in graduate school and on the job.

The grantee is matching the award from non-Federal sources.

|                                 |             |
|---------------------------------|-------------|
| James P. Hagen                  | USE 8851356 |
| University of Nebraska at Omaha | \$62,365    |
| Omaha, NE                       | Chemistry   |

**"Nuclear Magnetic Resonance (NMR) Spectroscopy Across the Curriculum"**

A Varian Gemini-200 Nuclear Magnetic Resonance (NMR) spectrometer is allowing more emphasis on the use of carbon NMR in the sophomore organic laboratory, introducing NMR kinetic experiments into the Physical Chemistry laboratory, and expanding the educational impact of the Instrumental Analysis and Spectroscopy courses. In addition, the undergraduate student research is being significantly improved. The American Chemical Society's Committee on Professional Training has emphasized the importance of introducing the students to modern instrumentation and the challenge of research as early as possible in their studies in order to attract students to Chemistry and to better prepare them for a career in the Chemical Sciences. The superconducting NMR is adding a new dimension to and injecting excitement into the program.

The grantee is matching the award from non-Federal sources.

|                     |             |
|---------------------|-------------|
| William D. Tothorow | USE 8851931 |
| Rivier College      | \$23,584    |
| Nashua, NH          | Chemistry   |

**"Incorporation of Fourier Transform Infrared Spectroscopy into the Undergraduate Chemistry Curriculum"**

A computer-controlled, Fourier Transform Infrared (FT-IR) spectrophotometer is being incorporated into a pro-

ject-based laboratory curriculum at this women's college. This laboratory program, developed over many years, involves students early with problem-solving and chemical instrumentation. The small classes permit introducing freshmen to basic spectral techniques and the FT-IR, in its one-button mode, is exposing these students to this powerful technology. Involvement with instrumentation is expanded through Organic Chemistry, Quantitative Analysis and an advanced lab in the junior year. The FT-IR is being used extensively in Physical Chemistry for kinetics experiments and to obtain high resolution spectra of gases. The FT-IR is greatly enhancing current experiments and numerous experiences, not previously possible, are becoming routine, including computer data handling, spectral database searches, and reflectance sampling methods. Exposing students to the FT-IR at progressively higher levels is allowing them to use all of its capabilities.

The grantee is matching the award from non-Federal sources.

Kamal Sinha  
Cumberland County College  
Vineland, NJ

USE 8852285  
\$97,095  
Chemistry

#### **"Plastics Processing Laboratory for Undergraduate Instruction"**

Cumberland County has traditionally been the center for glass manufacturing in New Jersey. Almost 60 percent of the local economy was directly and indirectly related to the glass industry. In recent years a variety of factors, including high energy costs, foreign competition, and consumer acceptance of plastic, have contributed to a sharp decline in this sector of the County's economy. Plant closings and large scale layoffs raised the local unemployment rate in 1984-85 to 18 percent. Cumberland County is consistently ranked as one of the top 10 unemployment areas in the country. Plastics manufacturing has begun to become an important aspect of the regional manufacturing base. Since a 1983 report on the industry was prepared by the New Jersey Department of Commerce and Economic Development, the number of plastic manufacturers in Cumberland County has doubled and the work force has increased by 53 percent. As the number of plastics manufacturers increase, the need for a skilled work force also increases. To meet this need the College has established a laboratory facility to support the offering of a new course, Processing of Plastics. This course is a core requirement in a new program for a Plastics Processing Technician Certificate Program which is serving both undergraduate students who will transfer and those who are working in the local area. The laboratory facility is giving the students hands-on experience in understanding the principles of processing plastics on machinery and test apparatus; in the melt flow characteristics of typical resins in extrusion, injection

molding, and compression molding; and in the testing of melt flow and physical properties of plastics in accord with commercial methods of characterization and assurance for the use in production.

The grantee is matching the award from non-Federal sources.

David K. Lewis  
Colgate University  
Hamilton, NY

USE 8852990  
\$23,300  
Chemistry

#### **"Incorporation of Gas Chromatography/Mass Spectrometry into Undergraduate Instruction"**

A quadropole mass spectrometer and associated computer hardware and software for instrument control and data analysis is being acquired. The instrumentation is being interfaced to an existing/packed column gas chromatograph, giving gas chromatography/mass spectrometry (GC/MS) and interactive data acquisition analysis capabilities which were previously nonexistent in the department. Students (both majors and non-majors) are using the apparatus in fulfilling laboratory assignments in Organic Chemistry, Instrumental Analysis, and Physical Chemistry courses. The equipment is also being used extensively by students in the required senior research program. While the program had previously integrated the chemistry subdisciplines within the laboratory program attached to individual courses, especially Instrumental Analysis, this is the first time the vertical integration has been accomplished. The progressively challenging and instructive hands-on exercises centered around the modern GC/MS is the cornerstone of the program.

The grantee is matching the award from non-Federal sources.

James A. Fahey  
CUNY Bronx Community College  
New York, NY

USE 8852184  
\$11,013  
Chemistry

#### **"Microcomputer Based Introductory Laboratories Using Titrations"**

This project is improving the quality and relevance of the first and second courses dealing with chemical analysis through the use of microcomputers and automated titrators. This is being accomplished through the use of four automatic titrators in conjunction with four microcomputers. This permits students to design and control automatic titrations; to collect and process data; to learn a greater number of volumetric methods including colorimetric, potentiometric and pH titrations; and to become familiar with the application of computers to new and old methods of

analysis. The automatic titrator/computer is being used to do a series of titrations involving acids and bases; redox titrations; and potentiometric titrations. The equipment is being used to teach students about a greater number of analytical techniques and making it easier to use the laboratory experiments to reinforce theoretical topics covered in the lecture. It is also enabling the teaching of methods of analysis through the use of computer simulation. In addition many laboratory skills are being taught in a more efficient and meaningful manner through the use of computers in the laboratory setting.

The grantee is matching the award from non-Federal sources.

|                                |             |
|--------------------------------|-------------|
| Reuben L. Baumgarten           | USE 8853006 |
| CUNY Herbert L. Lehman College | \$69,000    |
| New York, NY                   | Chemistry   |

**"Implementation of Gas Chromatograph-Mass Spectrometry for Undergraduates in Forensic Science and Organic Chemistry"**

The addition of a gas chromatograph-mass spectrometer to the instrumentation available for the instruction of undergraduate students provides opportunities for students to have direct hands-on experience with this modern instrumentation. An undergraduate course in Forensic Science requires that the students conduct measurements using this instrumentation. The Introductory Organic Chemistry laboratory has been changed to include mass spectrometry experiments that develop the student's understanding of these experimental methods.

The grantee provides funds for this project that are an equal match for the NSF award.

|                                           |             |
|-------------------------------------------|-------------|
| Lawrence Kobilinsky                       | USE 8851684 |
| CUNY John Jay College of Criminal Justice | \$35,300    |
| New York, NY                              | Chemistry   |

**"Using Pyrolysis-GC-MS to Enhance Student's Knowledge of Modern Instrumental Microanalytical Techniques and Methods of Science Research"**

Minority and disadvantaged students are learning microanalysis theory and techniques and modern scientific research methods. Objectives include: integrating a gas chromatograph—mass spectrometer (GC-MS) data system into a microscale organic laboratory; using GC-MS and pyrolysis for an instrumental analysis course; and developing two novel advanced courses on "Methods of Scientific Research." Innovative projects are being used in the use of antibodies for biochemical analysis using pyrolysis GC-MS

and the analysis of samples by pyrolysis GC-MS. Lab writeups and videotapes of the new experiments and instrument use are being prepared. Mastery of microanalytical techniques, research methods and computer skills is increasing the successful program completion by these students.

The grantee is matching the award from non-Federal sources.

|                  |             |
|------------------|-------------|
| Richard C. Reed  | USE 8851622 |
| Hartwick College | \$39,500    |
| Oneonta, NY      | Chemistry   |

**"Integration of Instrumental Methods into an Undergraduate Curriculum. Instrumental Analysis: It Isn't Just for Juniors Anymore"**

The utilization of major instrumentation to solve chemical problems is usually reserved for a course in Instrumental Analysis given in the third year of an American Chemical Society (ACS) approved degree program. With increasing numbers of students opting for non-ACS approved Chemistry degrees, fewer students are completing a chemistry sequence that includes instrumental analysis. Yet, it is important that today's students be familiar with state-of-the-art technologies and their capabilities in the arena of chemical analysis. A program to incorporate a graded introduction to instrumentation through a) demonstrations for freshmen and non-science major courses, b) use of such equipment for structural analysis and purity determinations for Organic Chemistry courses, c) understanding of the instrumental design in instrumental analysis, and d) incorporation as a resource tool in Senior Research projects is being introduced. The program is being developed around the three major spectroscopic techniques—nuclear magnetic resonance spectroscopy, Fourier transform infrared spectroscopy and mass spectrometry. The purchase of the mass spectrometer is completing the integrated spectroscopy program.

The grantee is matching the award from non-Federal sources.

|                             |             |
|-----------------------------|-------------|
| Daniel Lewicki              | USE 8852971 |
| Russell Sage Junior College | \$5,611     |
| Albany, NY                  | Chemistry   |

**"Acquisition of a Recording Infrared Spectrophotometer for Organic Chemistry"**

The acquisition of a recording Infrared (IR) Spectrophotometer is substantially improving the quality and quantity of Organic Chemistry instruction. Students majoring in the pre-professional programs in Chemistry, Biology, Environ-



mental Science and Nutrition are having the opportunity to gain first hand experience with IR spectroscopy, an important tool in the modern Organic Chemistry laboratory. The technique is enabling students to collect information about and describe the molecular structure of known and unknown organic compounds, to analyze mixtures of closely related compounds, to determine the purity of products from synthetic reactions, and to detect, identify, and measure the concentration of short-lived intermediates. By using IR spectroscopy, students are comprehending more fully the importance of instruments at every stage of structure determination, from isolation and purification to final comparison with an authentic sample, and are becoming familiar with equipment that is normally encountered by sophomores in four-year colleges. The students are being better prepared for transfer to the four year schools.

The grantee is matching the award from non-Federal sources.

Timothy Eckert  
Garon Smith  
SUNY College at Fredonia  
Fredonia, NY.

USE 8851903  
\$18,904  
Chemistry

#### **"Fourier Transform Infrared Spectroscopy for Undergraduates"**

A Fourier transform infrared spectrometer (FTIR) is being acquired for use in two areas of undergraduate instruction—structured laboratories and independent undergraduate research projects. Students at the Sophomore level are using the FTIR in microscale organic labs to perform quantitative analyses of products and to demonstrate organic reaction kinetics/mechanisms. Students in the Junior analytical laboratory sequence are assembling a network of interfaced instruments by combining the FTIR and its associated computer with a compatible spectrofluorometer. The students are using the FTIR to explore its ability to quantitatively analyze samples in a variety of physical states—aqueous solutions, dilute solutions, opaque solids, polymer coatings, etc. Students are using the networked spectrofluorometer to characterize a polynuclear aromatic hydrocarbon mixture with 3-dimensional fluoroscopy. Students in the extensive undergraduate research program are able to select from eight, FTIR-oriented research projects that have been designed by five faculty members (3 inorganic, 3 analytical/environmental, 1 organic, 1 polymer).

The grantee is matching the award from non-Federal sources.

Dennis P. Swauger  
SUNY Ulster County Community  
College  
Stone Ridge, NY

USE 8851801  
\$33,639  
Chemistry

#### **"Computerization of the General Chemistry Laboratory at Ulster County Community College"**

Microcomputers are being interfaced with laboratory instruments in the General Chemistry program. Student involvement is being maximized in the process of measurement, data acquisition, and data analysis. The efficiency and precision of laboratory measurements is being increased, as well as the student interest and understanding of the nature of the measurements and the principles of Chemistry that the laboratories are designed to illustrate. Four data acquisition devices, eight microcomputers directly connected to the devices, a hard disk drive and tape backup for software and data storage as well as a fileserver system are included. Each data acquisition device serves two student workstations. The workstations were completed with the purchase of: eight digital balances for routine mass measurements, three bomb calorimeter systems for calorimetric studies of foods and fuels, two spectrometers for routine quantitative analyses as well as equilibrium and kinetic studies, four pressure transducer systems and eight thermistor thermometer systems for temperature measurements.

The grantee is matching the award from non-Federal funds.

William F. Pfeiffer  
Utica College of Syracuse Univ  
Utica, NY

USE 8851770  
\$25,639  
Chemistry

#### **"Fourier Transform Infrared (FTIR) Spectroscopy in Undergraduate Laboratories "**

The project is a major step in the continuing enhancement of the inorganic and instrumental capabilities of the Chemistry program. A FTIR Spectrometer and associated computer software has been purchased for use by the students in the laboratories beyond the Freshman courses. The students are thereby gaining direct experience with a modern spectrometer and benefit from its speed and accuracy in their laboratory assignments. The students are also gaining direct experience with the power and convenience of the computational routines that are possible with digitized data.

The grantee is matching the award from non-Federal sources.

Christopher T. Bailey  
Wells College  
Aurora, NY

USE 8851384  
\$14,640  
Chemistry

**"Inorganic Chemistry" for Undergraduates:  
Necessary Instruments**

This small liberal arts college, which has a strong tradition of training women with a strong tradition of training women, is reintroducing a course in Inorganic Chemistry and requiring it for the Chemistry major. The course, which is being offered, is open to students of sophomore standing or higher. The instruments necessary for an undergraduate course in Inorganic Chemistry, a fast-scan UV/Vis Spectrophotometer, an Atomic Absorption Spectrometer, and a Magnetic Susceptibility Balance, were chosen due to the ease of obtaining and interpreting data, and the ability of these instruments to examine both gross physical properties and molecular and atomic properties. The experiments being performed with these instruments reinforce or substantiate the concepts introduced in the classroom, rather than simply giving the student "experience" doing a particular manipulation or using the particular instrument. For most experiments the students are working independently in obtaining certain data, but then, as a class, share and evaluate the data in discovering and developing patterns. By allowing sophomores to take this course they are hoping to give more students the opportunity to pursue advanced studies in Inorganic Chemistry.

The grantee is matching the award from non-Federal sources.

Charles G. James  
University of N C  
Asheville, NC

USE 8852645  
\$29,576  
Chemistry

**"Modernization of Experiments and Expansion of  
Undergraduate Instrument Techniques with an  
FTIR Spectrometer"**

A Fourier Transform Infrared Spectrometer (FTIR) is giving the students hands-on experience with modern infrared instrumentation and current infrared sampling techniques. With the spectrometer's integral computer the students are being exposed to computer controlled instrumentation and computer analysis of data earlier in their course work. The principles introduced by exposure of students to the FTIR are forming the basis of explanation of other instruments using transform methods or which are interfaced to computers. The spectrometer with its accessories is allowing the students to expand their analysis experience with mixtures, opaque solids, powders, and surfaces using reflectance techniques. The aqueous liquid cell is making possible the routine vibrational analysis of aqueous solutions. Current experiments in the department are being modified

and new experiments are being produced for undergraduate students which are taking into account the capabilities of an FTIR spectrometer, computer analysis of spectra and reflectance techniques for analysis. The range, sensitivity, and resolution of the instrument is also being used by students doing undergraduate research in organometallic synthesis and molecular structure.

The grantee is matching the award from non-Federal sources.

Hans-Georg Gilde  
Marietta College  
Marietta, OH

USE 8851498  
\$11,537  
Chemistry

**"Fourier Transform Infrared (FTIR) Spectroscopy in  
Undergraduate Chemistry"**

The upper level Chemistry Laboratories are being improved by the incorporation of Fourier Transform Infrared methods. The Chemistry courses which are using the new FTIR are Molecular Spectroscopy, Physical, Advanced Inorganic, Instrumental Methods of Chemical Analysis and Biochemistry. In addition, two chemically-oriented courses in geology (Mineralogy and Petrology) are using the FTIR. Compared to the dispersive IR instruments used previously, the FTIR provides better resolution, higher sensitivity and superior performance in the far IR region. While it is difficult to use dispersive IR for the analysis of impure liquids and solids, the FTIR (and its diffuse reflectance and multiple internal reflection accessories) are permitting students to gain hands-on experience with more modern analytical techniques, including mixture analysis and solution chemistry. Furthermore, students are becoming acquainted with the mathematical manipulations and computer methods involved in Fourier Transform techniques. As a result of this project, students are better prepared for graduate school and careers in industrial laboratories.

The grantee is matching the award from non-Federal sources.

Theodore L. Miller  
Lewis Fikes  
Ohio Wesleyan University  
Delaware, OH.

USE 8852693  
\$17,547  
Chemistry

**"A High Performance Liquid Chromatograph  
(HPLC) for Improved Instruction in Chemistry"**

The quality of scientific training offered to students is being improved with the purchase of a high performance liquid chromatography instrument for use in five laboratory courses. This is allowing the Department to include as a part of the students' scientific training the principles and

practice of HPLC—the most versatile method for separating and quantitating the variety of complex mixtures which chemists encounter. Introduction of the HPLC into the Chemistry Department's laboratory curriculum is enabling students to work with a wider range of mixtures—especially those containing non-volatile solids or thermally sensitive compounds—than was previously possible with the departmental instrumentation. For instance, the students are doing experiments involving the separation and quantitation of proteins in a mixture or determining the lipid composition of a cellular membrane. Including these new experiments in the laboratory program of the Department is significant because it is enhancing the ability of the science students to investigate chemical systems and solve chemical problems.

The grantee is matching the award from non-Federal sources.

James A. Duncan  
Lewis and Clark College  
Portland, OR

USE 8851627  
\$62,700  
Chemistry

#### **"Acquisition of a High-field Fourier Transform Nuclear Magnetic Resonance Spectrometer for Undergraduate Research and Instruction"**

A High-Field Fourier Transform Nuclear Magnetic Resonance Spectrometer System including variable temperature, hard disk, and coprocessor accessories is being used to introduce new experiments in the Physical, Inorganic, Advanced Analytical, and Introductory Organic Chemistry Laboratory Courses. The scientific productivity of the undergraduate research program is being substantially increased. Examples of student research projects which are being made possible by this instrument included: (I) studies of the stereochemistry of augmented thermal and photochemical Cope rearrangements; (II) synthesis and studies of the regio- and stereochemistry of dealkoxycarbonylation reactions of thienyl substituted polyalkoxycarbonyl ethenes as possible polythienyl precursors; (III) synthesis and conformational studies of Schiff base coordination compounds as possible laser materials; and (IV) the synthesis of silicone compounds of theoretical interest.

The grantee is matching the award from non-Federal sources.

Richard V. Whiteley  
Pacific University  
Forest Grove, OR

USE 8851866  
\$14,951  
Chemistry

#### **"Integrated High Performance Liquid Chromatograph for Undergraduate Instruction"**

A computer-controlled, modern, High Performance Liquid Chromatograph (HPLC) is providing the capability for

students to study state-of-the-art methods for separation and analysis of complex liquid solutions. Computer control is being achieved by purchasing appropriate hardware and software in lieu of the dedicated terminal normally supplied with the chromatograph. With this modification, the new chromatograph is being integrated into the existing computer network at the university, which will vastly increase the effectiveness of the instrument. Data acquisition, processing and storage and instrument control is becoming more flexible, and interaction with other instruments on the network (e.g., visible/ultraviolet spectrometer and gas chromatograph) is becoming feasible. The modernization of the HPLC capability is necessary for the Department to maintain adequate facilities for the education of the small group of Chemistry majors and the considerably larger group of Health Science majors. The instrument is being used throughout the Chemistry curriculum as well as throughout the Natural Science Division for undergraduate student research.

The grantee is matching the award from non-Federal sources.

John E. Hancock  
Ronald W. McClard  
Reed College  
Portland, OR.

USE 8852500  
\$100,000  
Chemistry

#### **"Acquisition of a High Field NMR Spectrometer, and its Integration into the Chemistry Curriculum"**

The Chemistry curriculum is being upgraded with the acquisition of a Bruker AC-E 250 MHz NMR spectrometer with a special probe unit allowing detection of resonances from proton, carbon-13, fluorine-19 and phosphorus-31 nuclei under (switchable) computer control. The analytical capability is being extended with the ability to analyze all four nuclei and the data is being processed via a computer. The present laboratory curriculum is being extended with the introduction of new NMR experiments in six courses and with the ability to do 2D analysis of spectral data and appropriate double resonance and pulse techniques in senior thesis research.

Students are running spectra on a user-friendly instrument in introductory organic and inorganic. Introductory organic is being converted to microscale syntheses and analyses with the increased sensitivity of the instrument. Senior thesis research is being facilitated with the new capability.

The grantee is more than matching the award from non-Federal sources.



Grace A. Banks  
Chestnut Hill College  
Philadelphia, PA

USE 8852679  
\$10,787  
Chemistry

**"Introduction of Fourier Transform Infrared (FTIR) Spectroscopy into the Undergraduate Chemistry Curriculum"**

The project is allowing the introduction of the important analytical technique of Fourier Transform Spectroscopy into the undergraduate Chemistry curriculum. Laboratory experiences in organic, physical, inorganic, biochemical, and analytical chemistry is being significantly enhanced by the acquisition of an FTIR spectrometer. The improvements in spectral quality and speed of acquisition of spectra is allowing upgrading of the laboratory exercises in IR spectroscopy and is permitting the introduction of new experiments into the curriculum. Experiments with data handling techniques possible on a computer-controlled FTIR instrument is providing students with relevant skills to take with them to graduate school or to industry.

The grantee is matching the award from non-Federal sources.

Kenneth R. Hess  
Franklin and Marshall College  
Lancaster, PA

USE 8851677  
\$32,773  
Chemistry

**"Applications Development for an Ion Trap Detector at an Undergraduate Level"**

Gas Chromatography/Mass Spectroscopy (GC/MS) is being integrated into the undergraduate laboratory experience. Current literature in Analytical Chemistry reveal a growing dependence upon GC/MS techniques, especially in the areas of Environmental Protection Agency priority pollutant analysis and in the rapidly expanding field of drug analysis. Exposure to such a system at the undergraduate level would be an advantageous introduction to advanced methods of chemical analysis. In particular, the Ion Trap System available from Finnigan MAT is being employed. This recently introduced instrument has several potential advantages for use at the undergraduate level including increased durability and lower maintenance than corresponding quadrupole or magnetic sector mass spectrometers and simplified operation through complete computer control. These factors are of primary importance for the undergraduate laboratory where the system is subjected to users with varying degrees of competence. The Department has recently converted the organic laboratory to microscale which results in an inherent dependence upon advanced instrumentation for analysis. The high selectivity and sensitivity of the GC/MS system is ideally suited for microscale analysis and the Ion Trap System is being incorporated into the Sophomore year Organic Chemistry for analysis of student prepared

compounds. Additionally, the instrument is being employed in Junior year Analytical Chemistry for the separation and analysis of multicomponent mixtures and for an introduction to computer controlled instrumentation through programming in FORTH language. The instrument is also becoming an integral part of the strong research program, allowing more efficient utilization of the instrument with year-round use.

The grantee is matching the award from non-Federal sources.

Richard D. Cornelius  
Lebanon Valley College  
Annville, PA

USE 8851260  
\$16,566  
Chemistry

**"The Introduction of an Atomic Absorption Spectrophotometer into the Chemistry Curriculum to Strengthen Laboratory Instruction"**

A Varian SpectrAA-10B Atomic Absorption Spectrophotometer and an accompanying computer-based data station is being used to introduce the principles and techniques of atomic absorption spectrophotometry into the curriculum at a number of levels. Specific course improvements being made include: Introduction of the atomic absorption method into Introductory Chemistry as a technique for the determination of the sodium content of over-the-counter medications and for the determination of the lead content of solutions of lead iodide; Demonstration of the principles of operation of an atomic absorption spectrophotometer and its analytical applications in an Instrumental Analysis course; and Use of atomic absorption spectrophotometry in independent study and in summer research programs. The equipment is also being used in the annual summer chemistry program for advanced high school students.

The grantee is matching the award from non-Federal sources.

Ellen P. O'Hara-Mays  
Lock Haven Univ of Pennsylvania  
Lock Haven, PA

USE 8852123  
\$11,389  
Chemistry

**"Learning Chemistry as a Process: Chemical Kinetics"**

This project presents an integrated approach by which the student is repeatedly presented with the concept of Chemical Kinetics in various courses. Each exposure to the concept is presented in increasing complexity. It is the goal of the Department to evaluate different methods of presenting this difficult concept. The faculty in each discipline have designed experiments which improve the laboratory curricula. In the Introductory and General Chemistry

courses, a qualitative demonstration in lecture and semi-quantitative laboratory is being used. In Organic Chemistry, which is generally the second year of a chemistry program, a thorough examination of the mechanism and other chemical parameters (e.g. steric hindrance) of a chemical reaction is being examined. The third year of the chemistry program includes Physical Chemistry where a more detailed calculus-based description of the chemical kinetics is introduced to describe the mechanism and possible description of reaction intermediates using mathematical models. The fourth year of the chemistry program includes Biochemistry. The student is being introduced to enzyme kinetics where the mathematical descriptions emphasized in Physical Chemistry are being applied to biological catalysts and extrapolated to the processes occurring in living systems. Other courses in the chemistry program are also teaching these principles, but the contributing courses fall into a chronological sequence and utilize chemical kinetics in their curricula. The students who are benefitting from these programs are the Chemistry majors, the students who are taking general education courses, and those students with majors in Science Education, Health Science and Biology.

The grantee is matching the award from non-Federal sources.

Robert B. LaCount  
Waynesburg College  
Waynesburg, PA

USE 8852592  
\$17,987  
Chemistry

#### **"Improvement of Infrared Spectroscopy Laboratory Experiences"**

The undergraduate Chemistry laboratory program is being improved by the incorporation of new infrared laboratory experiences. An infrared spectrometer has been purchased which is suitable for teaching, routine analysis and senior research applications. Increasingly complex laboratory utilization of the instrument is planned as the students progress from Organic Chemistry to Instrumental Analysis and Physical Chemistry and finally to Senior Research applications. These laboratory experiences are complementing and supplementing the student's present laboratory experiences which are centered around an array of basic instrumentation and a few more sophisticated items. These additional laboratory experiences are better equipping the graduates to meet the challenges of industry and graduate programs.

The grantee is matching the award from non-Federal sources.

Edward Stampf, Jr.  
Lander College  
Greenwood, SC

USE 8851562  
\$25,758  
Chemistry

#### **"FTIR for Enhanced Undergraduate Chemistry Instruction"**

A Fourier Transform Infrared (FTIR) Spectrometer has been acquired and is being used in Introductory Organic Chemistry, Advanced Organic Chemistry, Inorganic Chemistry, Chemical Instrumentation, Physical Chemistry and Chemistry research. The FTIR is being used to supplement existing laboratory techniques for elucidating structure, providing alternate methods of quantitative analysis and allowing for more sophisticated experimentation in upper division courses. In addition, Fourier transform methodology is being incorporated into the laboratory for the first time. Data manipulation and spectral search capabilities of the FTIR make it a powerful learning tool for students. Experience with the FTIR is assisting the students in remaining competitive in the job market where FTIR is fast becoming the norm.

The grantee is matching the award from non-Federal sources.

Duane E. Weisshaar  
Augustana College  
Sioux Falls, SD

USE 8851195  
\$15,765  
Chemistry

#### **"A Chromatography Module for the Chemistry Curriculum"**

The new Chromatography curriculum is exposing all of the Chemistry majors and many additional students to GC employing temperature programming, capillary columns, TCD, FID, and GC/MS; and to HPLC utilizing normal phase, reverse phase, ion and GPC columns; isocratic and gradient elution; and UV, fluorescence, conductivity, and refractive index detection. These students are gaining experience in the use of computers for data collection and analysis. They are increasing their ability to use computers to prepare formal scientific reports incorporating the analyzed data. In addition to the 2 HPLC's (one a gradient system), a GC/MS, and several student model GC's previously available in the department, this project has added a dual column, microprocessor controlled gas chromatograph with temperature programming and capillary column capability, a refractive index detector for HPLC, and a PC based chromatography data station. Thus, the experiments in seven courses and student-faculty research is extending the students' understanding and appreciation of chromatography as a tool for a wide variety of applications as well as giving them experience using computers and computer controlled instrumentation for Chemistry laboratory applications.

The grantee is matching the award from non-Federal sources.

Diane L. Simmons  
Austin Peay State University  
Clarksville, TN

USE 8852900  
\$11,423  
Chemistry

**"Integration of an Atomic Absorption Spectrophotometer into the Chemistry Curriculum"**

A state-of-the-art Atomic Absorption (AA) spectrophotometer is being incorporated into several Chemistry courses. It is being used in an Instrumental Analysis course, an Inorganic course, a Physical Chemistry course, and for student research. Students are getting hands-on experience in the operation of the AA, which employs microprocessor controlled operation and a self-contained microcomputer. Data is displayed on a CRT and can be printed or plotted if desired. Students from local high schools also spend a day at the university working with the instruments and observing. One of the projects of interest to the students is the investigation of the concentration of metals in the groundwater of Humphreys County, Tennessee.

The grantee is matching the award from non-Federal sources.

Kevin M. Ogle  
Rhodes College  
Memphis, TN

USE 8851358  
\$22,697  
Chemistry

**"Surface Reactions, Material Science, and Computer Controlled Instrumentation with Fourier Transform Infrared Spectroscopy in Undergraduate Instrumental Analysis"**

Experiments involving the analytical chemistry of materials (with special emphasis on polymers) and surfaces are being introduced in the senior Instrumental Analysis course using Fourier transform infrared spectroscopy. Diffuse reflectance and photoacoustic detection is being used to illustrate the analysis of opaque samples such as polymer fibers, coal, soil, and minerals. The analytical characterization of surface species on polymer or metal surfaces is being illustrated using specular reflectance and attenuated total reflectance. Such experiments are illustrating the power of modern spectroscopic techniques as applied to complex, heterogeneous systems and are exposing the students to problems of a very practical "real world" nature.

The basics of computer controlled instrumentation is also being stressed. The experiments are using spectral subtraction and normalization software routines, as well as the spectral libraries for the analysis of polymer mixtures.

The grantee is matching the award from non-Federal sources.

Irving T. Glover  
Roane State Community College  
Harriman, TN

USE 8852155  
\$5,332  
Chemistry

**"Scanning Spectrophotometry in Organic Chemistry"**

Students in Organic Chemistry and in special problems courses in scientific research are doing experiments in the ultraviolet and visible region of the spectrum. Students are gaining experience with their own spectra of organic compounds for spectra structure correlations and learning to operate a modern, programmable, computer-directed spectrophotometer equivalent to those used in industry and national laboratories. The students are doing experiments such as the measurement of the spectra of aniline, the anilinium cation, and nitrobenzene. They are then considering the displacement and enhancement of absorption bands in the spectrum due to the structural substitution of the amino group on the aromatic ring, the disappearance of the shift and enhancement when the amino group is converted to the anilinium cation, and the appearance of additional bands when the structural change involves substitution of a nitro group on the benzene ring.

The grantee is matching the award from non-Federal sources.

Robert L. McNeely  
Univ of Tennessee  
Chattanooga, TN

USE 8853033  
\$8,140  
Chemistry

**"Electrochemical Instrumentation for Undergraduate Instruction"**

A comprehensive state-of-the-art electrochemical instrument is being acquired to allow hands-on experience in teaching young student scientists basic electroanalytical chemical instrumental methods of analysis such as polarography, pulse polarography, stripping voltammetry, and cyclic voltammetry. The system includes a control unit, a static mercury drop electrode unit and a digital plotter. The instrument is being used each year by 80 students in five undergraduate courses which serve Chemistry majors. Direct experience with up-to-date scientific equipment is essential to modern science. It is anticipated that better trained scientists entering graduate and professional schools and beginning professional science careers will result.

The grantee is matching the award from non-Federal sources.



Charles E. Harding  
University of Tennessee  
Martin, TN

USE 8851275  
\$26,283  
Chemistry

Treacy L. Woods  
Houston Baptist University  
Houston, TX

USE 8851142  
\$26,150  
Chemistry

#### **"Undergraduate Instruction in Gas Chromatography/Mass Spectrometry"**

Technological advances over the past few years have produced some remarkable changes in laboratory instrumentation. It is essential that undergraduate science students develop a thorough understanding of both the theoretical and practical aspects of modern computer-controlled/computer-interfaced instrumentation. One of the most powerful instrumental methods for separating and identifying the components of a complicated mixture is Gas Chromatography/Mass Spectrometry (GC/MS). Students of Chemistry, Biology and other sciences are being educated in the theory, operation, practices and capabilities of this powerful technique. GC/MS is being introduced into Analytical and Organic Chemistry during the sophomore year. Six upper-level courses are being improved to give the student ample opportunity to gain proficiency in the technique. The infrastructure of science is being strengthened when young scientists no longer have to remove, in graduate schools and in industrial laboratories, deficiencies accumulated as undergraduates because of the lack of the state-of-the-art instructional scientific equipment.

The grantee is matching the award from non-Federal sources.

Peggy Alley  
Amarillo College  
Amarillo, TX

USE 8852342  
\$21,307  
Chemistry

#### **"Instrumentation and Laboratory Improvement in the Chemistry Department"**

The Chemistry laboratory offerings are being upgraded with the acquisition of Spectronic 20 model D spectrophotometers and Westronics recorders, a Shimadzu UV spectrophotometer, electronic balances and a Perkin Elmer FT-IR 1600 spectrophotometer. Instrumental methods are being introduced into Freshman courses followed by expanded usage in the Sophomore courses. Students are preparing inorganic and organic compounds and then using the instruments to characterize them, as well as study their spectroscopic properties. By using both Spectronic 20's and a recording UV spectrophotometer, students are being given the opportunity to see the impact that instrumentation can make on a determination.

The grantee is matching the award from non-Federal sources.

#### **"Use of Hands-On Nuclear Magnetic Resonance Spectroscopy to Strengthen the Organic Chemistry Laboratory Program"**

With the acquisition of a nuclear magnetic resonance spectrometer the Chemistry Department is strengthening its laboratory courses by providing students with additional opportunities to use instrumentation. Compound identification capabilities are being increased, particularly in the Organic Chemistry Analysis Laboratory. However the students also take a Senior Seminar, which is an undergraduate laboratory research course, where the instrument is having a decided impact on the nature of the problems that can be undertaken.

The grantee is matching the award from non-Federal sources.

Ronald E. Marcotte  
Texas A & I University  
Kingsville, TX

USE 8851305  
\$26,591  
Chemistry

#### **"Analysis of Natural and Synthetic Organic Mixtures in an Undergraduate Laboratory"**

The project is allowing students to experience one of the most powerful, modern techniques of chemical mixture analysis. The ability of the University to analyze organic substances is being greatly enhanced by the purchase of a benchtop Gas Chromatograph/Mass Spectrometer (GC/MS) System. Methods for analysis of air-borne and water-transferred organic components from the many petroleum, petrochemical, and agricultural industries in South Texas are being developed in Environmental Chemistry. In Instrumental Analysis, applications of this modern technique are being presented for student instruction. With the GC/MS, experiments exploring reaction mechanisms through product distributions and the use of isotope tracers are being developed for the Advanced Synthesis Laboratory. All of the above activities can apply to problems in Undergraduate Research. The GC/MS is reducing the separation and analysis time needed for many projects to the point where undergraduates can realistically consider completing some quality research during their short tenure. The significance of the project is great for the education of the population of South Texas.

The grantee is matching the award from non-Federal sources.

Michael P. Doyle  
Trinity University  
San Antonio, TX

USE 8851397  
\$17,492  
Chemistry

#### **"Trace Elemental Analyses in Chemistry and Geology"**

Atomic absorption spectroscopy and its uses for trace elemental analyses are being integrated into introductory and advanced courses offered by the Departments of Chemistry and Geology. Introduction to this fundamental analytical capability, whose applications extend into virtually every field of inquiry where accurate measurements of specific metals are required, is occurring in the first course in Chemistry, with advanced courses in Instrumental Analyses and Geochemistry expanding upon the initial experience. New instructional materials and laboratory experiments are being developed to facilitate student understanding of this technology and its broad applications in all fields of materials science. Application of atomic absorption spectroscopy suitable to nonscience majors and preservice teachers is being implemented, and access and instruction is being provided to area high school classes for their ongoing environmental research. Development of this program is being achieved through the purchase of an atomic absorption spectrometer equipped with a sample changer and accessories needed to obtain quantitative analyses at the part per billion range.

The grantee is matching the award from non-federal sources.

Dennis S. Rushforth  
University of Texas  
San Antonio, TX

USE 8852667  
\$21,110  
Chemistry

#### **"Enhancement of the Teaching of Instrumental Methods through Fluorescence Spectroscopy"**

One goal of experimental instrumentation courses should be to teach students of Chemistry how to use high-resolution, high-sensitivity equipment. Students should have the opportunity of making measurements near the limit of detectability of this type of instrument and be required to do it well. Most students that continue in Chemistry will find that an important part of their time is spent either in making such measurements or in interpreting them. Sadly, students are often taught to make such measurements on older equipment or on teaching equipment. Often the instrument itself is the biggest source of error in the experiment and students learn how to blame the instrument rather than use it. To challenge students to do their best and to strengthen the instrumentation courses, a high sensitivity, high resolution spectrofluorometer is being used in Instrumental Analysis and in Physical Chemistry. The technique is easy to learn and the instrument is modestly priced. The tech-

nique is more sensitive than absorption spectroscopy and is providing a myriad of applications for teaching principles through experimentation rather than just teaching how to turn on a machine. The equipment is also offering an opportunity for interesting and challenging undergraduate research projects.

The grantee is matching the award from non-Federal funds.

Elizabeth M. Hairfield  
Mary Baldwin College  
Staunton, VA

USE 8851924  
\$31,250  
Chemistry

#### **"Enhancement of the Curriculum through GC-MS"**

A Hewlett-Packard 5890A/5870B gas chromatograph with a mass selective detector, including ion gauge, data system and software is being utilized in this project. Nearly 80% of the student research in Chemistry, Biology and Psychology is being facilitated, with at least 60% of the science majors learning the principles and some applications of this important analytical method. The young women are being better prepared to enter graduate school and the work force in science. Significant student research is being produced and disseminated through presentations at professional meetings and in the appropriate technical journals.

The grantee is matching the award from non-Federal sources.

Billie J. Farrier  
Radford University  
Radford, VA

USE 8851763  
\$18,035  
Chemistry

#### **"Fourier Transform Infrared Spectroscopy in the Undergraduate Laboratory"**

A Fourier Transform Infrared Spectrometer is being purchased for use by the undergraduate students as a part of their educational program. This instrumental technique is widely used in both industrial and educational applications. The Fourier transform technique with its computer interface provides a method for analyzing a wider range of samples with a greater sensitivity than is possible with ordinary infrared instruments. Prior to the purchase of this instrument, the students could not become proficient in this technique. The teaching/research sensitive instrument that is being acquired is enhancing the laboratory experience of the students.

The grantee is matching the award from non-Federal sources.

Daniel Y. Pharr  
Virginia Military Institute  
Lexington, VA

USE 8851885  
\$10,650  
Chemistry

#### **"Fourier Transform Infrared for Chemistry"**

Fourier Transform Infrared (FTIR) Spectroscopy is being introduced into the undergraduate curriculum. The use of an FTIR affects more laboratory courses than any other instrument that could be purchased by the department. In General Chemistry the students are being introduced to the matching of an unknown spectra with a library. The characteristics and theory of FTIR are being studied in Instrumental Analysis. The quantitative and qualitative aspects are being used in Organic, Qualitative Organic, Polymer Chemistry and in the undergraduate research program. Physical characteristics of chemical bonding and kinetics are being studied in Physical Chemistry and Inorganic Synthesis. The students are gaining a deeper appreciation and broader perspective of modern high technology which should increase their enthusiasm for Chemistry. The technique which is widely used in industry and graduate research is allowing the students to have hands on experience using a computer controlled data manipulation device that is one thousand times faster than a dispersive infrared instrument.

The grantee is matching the award from non-Federal sources.

Neil E. Jacobsen  
Evergreen State College  
Olympia, WA

USE 8852442  
\$64,410  
Chemistry

#### **"High Field Fourier Transform Nuclear Magnetic Resonance (NMR) in an Integrated Physical Science Curriculum"**

The Chemistry faculty are updating and expanding their Chemistry and Biochemistry curriculum. A high-field Fourier Transform NMR spectrometer is being used in the teaching of Organic Chemistry, Physical Chemistry, and Biochemistry as well as in student-initiated studies and faculty-sponsored research. The capability of obtaining high-resolution proton and carbon-13 spectra of complex molecules is essential in structure determination of natural products, verification of synthetic products, and the study of reaction mechanisms. Hands-on student exposure to a technology as important to the chemical and biological sciences as high-field NMR is dramatically improving the teaching of science at Evergreen. The instrument is being used as the primary analytical tool in Organic Chemistry, and is exposing students in Physical Chemistry and Biological Sciences, through specific experiments and student projects to the technique.

The grantee is matching the award from non-Federal sources.

Lyle B. Peter  
Seattle Pacific University  
Seattle, WA

USE 8852019  
\$34,381  
Chemistry

#### **"Nuclear Magnetic Resonance Spectroscopy in Undergraduate Laboratories"**

A Nuclear Magnetic Resonance Spectrometer equipped with a decoupler accessory is adding to the student's laboratory experience in several levels of undergraduate courses. New experiments are being added to the organic course to introduce the students to the instrument. This is being followed with new experiments in Inorganic, Physical, Analytical and Biochemistry laboratory courses. The instrument is also providing expanded opportunities for undergraduate research.

The grantee is matching the award from non-Federal funds.

Jerrold P. Lokensgard  
Lawrence University  
Appleton, WI

USE 8851800  
\$95,250  
Chemistry

#### **"Acquisition of a High-field Fourier Transform NMR Spectrometer to Enhance Undergraduate Education in Chemical Spectroscopy"**

A 250 MHz Fourier Transform Nuclear Magnetic Resonance (NMR) Spectrometer is replacing a 14-year-old 60 MHz NMR spectrometer. The new instrument's ease of routine use, much higher sensitivity, and greater spectral dispersion is enhancing use of NMR in Organic, Inorganic, and Advanced Chemistry courses. In addition, the laboratory experiences of intermediate and advanced Chemistry students, both Chemistry majors and others, is being enriched by important new NMR capabilities. Carbon NMR is taking its place alongside proton NMR as a key ingredient of the Organic Chemistry Laboratory. Students in instrumental analysis and advanced laboratory courses are exploring molecular structure using two-dimensional NMR analysis, obtaining meaningful kinetic data more easily, and better understanding fundamental principles upon which NMR experiments rest. The new instrument is enhancing research training of senior undergraduates by greatly extending the range of accessible projects for student independent study. The department's curriculum is being enlivened by the addition of these new capabilities, and its students are being better prepared for postgraduate study or employment in the sciences.

The grantee is matching the award from non-Federal sources.



Richard G. Scamehorn  
Ripon College  
Ripon, WI

USE 8851154  
\$21,000  
Chemistry

Mary C. Hassinger  
Viterbo College  
La Crosse, WI

USE 8852192  
\$18,636  
Chemistry

#### **"Fourier Transform Infrared Spectroscopy in the Undergraduate Curriculum"**

Acquisition of a Fourier Transform Infrared Spectrometer is improving the instruction in Chemistry. The instrument replaced an aging dispersive IR spectrometer. Students are using a modern computer-controlled instrument which utilizes the Fourier transform method, which are two of the more important developments of the last few years. Two modern sampling accessories are extending the use of the IR to samples for which spectra previously could not be obtained. The instrument is being used in organic, physical, analytical, and advanced laboratory courses as well as in the undergraduate research program. Significant use in the non-majors courses is providing the non-science students with exposure to the power of computer search and spectroscopic techniques in identification and analysis of polymers and drugs.

The grantee is matching the award from non-Federal sources.

#### **"Instrumentation for Improving Undergraduate Instruction in Gas Chromatography"**

Gas Chromatography (GC) is being integrated across the curriculum with the concepts, practice and specialized uses of modern separations technology being employed. Significant improvement in the laboratory component of the curriculum is resulting with the introduction of both general purpose and research grade GC instruments. Three general purpose GC instruments have been purchased in order to introduce chromatography concepts to General Chemistry students. They are being used as an integral part of sample analysis in the Organic Chemistry laboratory and as a quantitative analysis tool for the Analytical Chemistry laboratory. A research grade capillary GC coupled with a chromatography workstation and a purge and trap analyzer has been purchased for use in the Advanced Analytical and Organic, Physical, Inorganic, and Individual Research courses. Efficient GC separations, computer collection and manipulation of data, and the ability to study a wide variety of samples utilizing purge and trap techniques is allowing new, relevant laboratory experiences to be offered to Chemistry majors, and is enhancing student research capabilities.

The grantee is matching the award from non-Federal sources.

## **COMPUTER SCIENCE**

Robert S. Cunningham  
California State College  
Turlock, CA

USE 8852038  
\$47,858  
Computer Science

Kasi Ananthanarayanan  
San Diego State University  
San Diego, CA

USE 8852913  
\$27,707  
Computer Science

#### **"A Workstation Environment for Computer Science"**

This project enhances the upper level computer science offerings at this institution by providing students with high-efficiency work stations and specialized programming tools. The laboratory that supports this project includes networked SUN workstations and such software as Franz Extended Common Lisp, Smalltalk, MProlog, Ada and expert systems tools. Using this laboratory, students are exposed to some practical programming projects that would not be possible using conventional microcomputers.

This award is being matched by an equal sum from the grantee.

#### **"Multiprocessor Architecture for Undergraduate Instruction"**

The equipment funded by this award permits undergraduate students to carry on programming assignments, large scale projects and undergraduate research in the areas of parallel architectures, distributed operating systems, fault tolerant systems and their applications in various areas. The equipment that supports this project includes ten Motorola processor boards and a host computer to house them, the UNIX operating system, ethernet controller, and a collection of software for the environment.

This award is being matched by an equal sum from the grantee.

August E. Sapega  
Trinity College  
Hartford, CT

USE 8851522  
\$22,010  
Computer Science

#### **"An Undergraduate Computer Graphics Laboratory"**

The equipment funded for this project supports a new upper-level Computer Science course in graphics at this institution, a course that serves as the capstone course within a graphics programming concentration. In addition, the laboratory equipment serves as the primary support for a senior-level mathematics course in fractals and chaos.

The laboratory that supports these projects includes Sun color graphics workstations, a printer and plotter, and various pieces of graphics software.

This award is being matched by an equal sum from the grantee.

Marilynn L. Livingston  
Southern Illinois University  
Edwardsville, IL

USE 8852165  
\$45,875  
Computer Science

#### **"Parallel Computing in the Undergraduate Curriculum"**

This project introduces undergraduate Computer Science students to parallel computing through coursework and laboratory experiences.

The laboratory consists of an Intel model D3-4 hypercube connected to the University's MicroVAX II systems over a local area network. The programming languages Fortran, C and LISP are available for parallel algorithm development.

Through the new course offerings in parallel computing, students study: parallel machine architectures, operating systems for parallel machines, languages and algorithms for parallelism. Through this project, students are given hands-on experience in an area that is gaining increasing importance in computing.

This award is being matched by an equal sum from the grantee.

Barry J. Farbrother  
Rose-Hulman Institute of Tech  
Terre Haute, IN

USE 8851364  
\$85,000  
Computer Science

#### **"Development of a Flexible Microcomputer Laboratory for Teaching Digital Electronics and Microcomputers"**

This project enhances Computer and Electrical Engineering courses at this institution. Modular microcomputer systems and associated development hardware provide a

high degree of configuration flexibility for use in both electrical engineering and computer engineering. The support equipment for this project includes personal computers that are utilized for digital logic design capability using programmable logic devices, for digital simulation, for software development and in-circuit-emulation. Using this lab, students experience the complete (hardware and software) design cycle from conception through design refinement and debugging, to the realization of a functional stand-alone embedded computer system.

This award is being matched by an equal sum from the grantee.

James Freeman  
Cornell College  
Mount Vernon, IA

USE 8852519  
\$67,745  
Computer Science

#### **"Integrating Graphics Workstation Technology into the Computer Science Curriculum"**

This project supports curriculum improvements in Computer Science at this institution. Using graphics-based, windowed workstations that are networked, existing courses have been modified and a new course in Computer Graphics introduced. The equipment supporting this project includes: Apollo DN3000 and DN4000 workstations; DEC, Apple and Tektronix printers; and software including UNIX, Modula2, Lisp, and C. In addition to using facilities for improving their programming skills, students are also exposed to software development, network management and graphic tools.

This award is being matched by an equal sum from the grantee.

Gloria L. Drapac  
Mount Mercy College  
Cedar Rapids, IA

USE 8851377  
\$69,355  
Computer Science

#### **"ADA in Undergraduate Computer Science"**

This project introduces topics in data abstraction and concurrent programming at the lower division using the programming language ADA. The curriculum changes are supported by state-of-the art equipment and software.

The laboratory equipment includes: four (4) SUN 3/50M workstations connected to a SUN 4/280S Server through an Ethernet connection and dial-up connections for external users.

In addition to curriculum changes at the lower division, this project introduces workshops for students who have completed the lower division so that ADA can be phased into upper division courses as well.

This award is being matched by an equal sum from the grantee.

Bryce A. Babcock  
Williams College  
Williamstown, MA

USE 8852643  
\$25,869  
Computer Science

#### **"Robotics Lab for Non-Science Majors"**

This project introduces undergraduate non-science majors to topics in science and technology through a laboratory experience involving robotics. The equipment supporting this project includes: Rhino Robot mobile and articulated arm robots, pneumatic actuators, ultrasonic ranging devices and visual imaging systems. Laboratory exercises are designed to introduce students to various reference frames, linear and rotational motion, concepts of work, energy and power, feedback control and various sensing devices.

This award is being matched by an equal sum from the grantee.

David W. Kammer  
Albion College  
Albion, MI

USE 8852986  
\$5,835  
Computer Science

#### **"Course Improvement in Artificial Intelligence and Robotics"**

This project supports undergraduate education in Artificial Intelligence and Robotics at this institution. A high quality, modern course is offered in a liberal arts context so that students become knowledgeable in a field that is critical to the Nation's manufacturing systems.

The equipment that supports this project includes: a high-speed dedicated computer system with image digitizer, TV camera, robot arm and expert systems, and robotics software.

This award is being matched by an equal sum from the grantee.

Sadali N. Jayaramamurthy  
Central Michigan University  
Mount Pleasant, MI

USE 8852142  
\$27,619  
Computer Science

#### **"Digital Image Processing Laboratory"**

This project supports a Digital Image Processing course in a state where expertise in this technology is in critical need. The laboratory supporting the project includes a VAX station II/GPX running the Ultrix-32 operating system. The Vax station controls diskless monochromatic workstations connected via ethernet that serve as student workstations. Image acquisition is accomplished via a Panasonic WV-D50 solid state black and white camera, a frame grabber and a frame processor. Using the laboratory, undergraduate stu-

dents gain hands-on experiences using hardware/software image processing tools.

This award is being matched by an equal sum from the grantee.

Ishwar Rattan  
Central Michigan University  
Mount Pleasant, MI

USE 8851239  
\$14,310  
Computer Science

#### **"Operating Systems Laboratory Using Microcomputer Based Workstations"**

This project permits undergraduate students in the Computer Science program to have a practical laboratory experience associated with the study of operating systems. The equipment that supports the project includes fifteen Zenith microcomputers running the MINIX operating system. Using the source code of this operating system, students gain a hands-on experience in modifying the operating system.

This award is being matched by an equal sum from the grantee.

Mildred Lintner  
Eastern Michigan University  
Ypsilanti, MI

USE 8852658  
\$37,461  
Computer Science

#### **"Computer Science Teacher Education Laboratory"**

This project uses a specialized computing laboratory to support a Computer Science Secondary Teacher Certification program.

The Computer Science Teacher Education Laboratory includes a mixture of the IBM-PC family as well as Apple II/Macintosh series of computers. Using this collection of equipment, prospective teachers are exposed to hardware and software that is pervasive in industry, business, education and in homes.

The laboratory is used as an integrated applications environment in the curriculum for teachers of Computer Science in the secondary schools. The courses in this program demand extensive and active laboratory experiences in order to prepare prospective teachers for an effective classroom environment.

This award is being matched by an equal sum from the grantee.

Karl W. Knight  
Gustavus Adolphus College  
Saint Peter, MN

USE 8852834  
\$31,115  
Computer Science

#### **"Artificial Intelligence Course Development Project"**

This project permits students at this institution to study Artificial Intelligence (AI) as an interdisciplinary course—



one involving both the principles of programming AI problem solutions as well as the study of issues of cognitive science. The new AI course is offered as a capstone course in that students develop one or two very complex LISP programs in the area of AI. The laboratory equipment that supports this project includes: networked Apollo DN3000 and DN4000 workstations running LISP.

This award is being matched by an equal sum from the grantee.

G. Michael Schneider  
Richard K. Molnar  
Macalester College  
Saint Paul, MN.

USE 8853215  
\$39,186  
Computer Science

#### **"An Introductory Computer Science Laboratory"**

In addition to revising the course content of Introductory Computer Science, this project revises the computer science laboratory experience so that it is highly structured.

Unlike the laboratory component of physical and natural science courses, computing labs tend to be informal. Students are given programming assignments which they complete on their own time. Frequently, laboratory sessions are not scheduled. This project introduces a highly structured lab into the introductory course where a large screen projection system is used to give demonstrations and pre-planned lab activities are designed to clarify a concept, demonstrate an idea or teach a skill. The laboratory hardware consists of Macintosh II computers that are networked, the software is the UNIX operating system and Turbo Pascal.

This project also substantially revises the Introductory Computer Science course content in the courses for both non-majors and majors. The course for non-majors, rather than being the typical "appreciation" course, is an integrated survey of the fundamental and central principles of computer science. For example, students are exposed to a Turing Machine simulator where they can observe and experiment with this model. The course for majors is revised from being only a programming course to one where students are exposed to a vast collection of software development resources such as: syntax-directed editors, hierarchical file systems, windowing systems, code profilers, optimizers, assertion checkers, on-line documentation and help packages, and network mail.

This award is being matched by an equal sum from the grantee.

Ali R. Delavari  
University of Minnesota Duluth  
Duluth, MN

USE 8851460  
\$87,865  
Computer Science

#### **"Equipment for Signal Processing/Communication Laboratories"**

This project permits undergraduate students to have hands-on experiences with state-of-the-art equipment in this institution's signal processing and communications laboratory. The laboratory that supports this project includes: HP Spectrum Analyzers, Wavetek function generators, Tek digitizing oscilloscopes, TI Digital Signal Processing 320's, Tandy 4000's with hard disks, color monitors and graphics display adapters.

Using this laboratory equipment, students obtain a solid background in linear systems, signal processing and communication systems as well as experience with the tools they will use in industry.

This award is being matched by an equal sum from the grantee.

John B. Garner  
Tougaloo College  
Tougaloo, MS

USE 8852861  
\$70,739  
Computer Science

#### **"Computer Science Curriculum Improvement"**

This project supports curriculum enhancements in this institution's undergraduate Mathematics/Computer Science program. With the equipment supported by this award, students in Computer Science are able to study advanced topics in Computer Science, to gain intuitive understanding of some mathematical principles through programming and to practice state-of-the-art computing techniques. The laboratory equipment supporting this project includes: DEC VAX 8250, controller, DECNET and various compilers and other system and application software.

This award is being matched by an equal sum from the grantee.

Thomas J. Myers  
Colgate University  
Hamilton, NY

USE 8851192  
\$24,027  
Computer Science

#### **"An Undergraduate Artificial Intelligence (AI) Laboratory"**

This project supports the enhancement of an existing Artificial Intelligence course and the introduction of a new Natural Language Processing course at this institution. The equipment funded by this award builds on an already existing lab and includes: Sun 3/60/M-8 workstations and Ze-

nith PCs interconnected (with existing equipment) via Ethernet. Using this laboratory, undergraduate students in Computer Science study not only theoretical issues of artificial intelligence and natural language processing, but also practical issues related to programming in these areas.

This award is being matched by an equal sum from the grantee.

Ronald G. Matteson  
Rochester Institute of Tech  
Rochester, NY

USE 8851810  
\$38,465  
Computer Science

#### **"Digital Document Processing Laboratory System"**

This project provides undergraduate students in Computer Engineering, Computer Science, and Electrical Engineering the opportunity to design, implement, and test the significant elements of office automation systems used to process documents in digital form. It provides the necessary equipment to augment a new digital image processing laboratory. Scanners, displays, printers, and array processors, working in conjunction with new and existing PC/AT-type computers, enable the students to capture, display, process, and print hard-copy data. This equipment is used primarily by students in a new undergraduate Computer Engineering concentration called Digital Document Processing. It also provides the Electrical Engineering students additional laboratory facilities in their digital signal processing concentration. Computer Science students use the instrumentation to provide laboratory experiences augmenting previous optional hardware courses.

This award is being matched by an equal sum from the grantee.

John W. McCormick  
SUNY College at Plattsburgh  
Plattsburgh, NY

USE 8852686  
\$41,711  
Computer Science

#### **"Distributed Processing and Computer Control"**

This project provides students with training in real-time computer control using a hardware/software environment that supports concurrency and distributed processing.

The programming training received by most Computer Science undergraduates does not lend itself to application to real-time control of complicated systems. Curricula are changing to meet the need for programmers who can function in a systems control environment. However, too frequently students must be satisfied with learning about theoretical models without seeing those models applied to real problems. Also, many theoretical models gloss over some practical issues having to do with the control environment.

This project not only exposes students to state-of-the-art software development tools for real-time systems control, but it also provides them with a flexible physical test-bed for their programs.

This award is being matched by an equal sum from the grantee.

Edward G. Pekarek  
Appalachian State University  
Boone, NC

USE 8852020  
\$16,175  
Computer Science

#### **"Computer Operating Systems Instructional Improvement Project"**

This project permits undergraduate students in Computer Science to experiment with practical operating systems programming in a laboratory environment. Working in teams, students both modify and enhance an existing operating system. The laboratory that supports this project includes PC-AT clones (with floppy and hard drives) running the MINIX operating system. The laboratory experience permits students to gain practical knowledge about operating systems, knowledge that is often overlooked in a traditional operating systems course.

This award is being matched by an equal sum from the grantee.

Robert Geitz  
Oberlin College  
Oberlin, OH

USE 8851262  
\$37,337  
Computer Science

#### **"Computer Graphics for Majors and Non-Majors"**

The project introduces both majors in computer science and non-majors to topics in computer graphics through the introduction of two new courses: one for Juniors and Seniors in Computer Science and one for non-majors at an introductory level. The equipment that supports this project includes: SUN 3/60 color workstations; a SUN color monitor, color board and mouse for a file server; a 280 megabyte disk drive; SUN graphics board and enhanced graphics processor; network cabling; and, associated software.

This award is being matched by an equal sum from the grantee.

Daniel C. Hyde  
Bucknell University  
Lewisburg, PA

USE 8853185  
\$63,354  
Computer Science

#### **"A Parallel Computation Laboratory"**

This project permits students to study issues of parallel computation and parallel processing in a flexible, reconfigurable laboratory.

As parallel processing becomes increasingly important in computing, students of Computer Science need to be exposed to facilities that will allow them to explore, in depth, the concepts and limitations of different parallel computational models. The parallel computation laboratory that supports this project is equipped with six (6) parallel processing machines. Each machine contains eight (8) processors which may be connected in a variety of ways including a ring, a pipeline, shuffle-exchange and hypercube. The six parallel machines are connected to one network server allowing the 48 processors to be integrated as one large "supercomputer". Student access to the parallel equipment configuration is via six high efficiency workstations suitable for parallel-program development and debugging.

By being exposed to different parallel computer configurations, students in this project are prepared for an area of computing that is becoming increasingly important both as a practical and research topic.

This award is being matched by an equal sum from the grantee.

Patricia A. Wenner  
Bucknell University  
Lewisburg, PA

USE 8853222  
\$55,000  
Computer Science

#### **"Computer Graphics Animation"**

This project permits undergraduate students to develop graphic software (with film recording) that animates certain graphic algorithms. The laboratory that supports this project is equipped with Sun workstations and a film recorder. Students develop and record graphic algorithms for Computer Science and other disciplines. Experimentation in this laboratory not only allows students to gain insight into the area of visualization techniques but they also produce materials that are used for graphical display of phenomena useful in courses in other departments.

This award is being matched by an equal sum from the grantee.

John C. Slimick  
Univ of Pittsburgh  
Bradford, PA

USE 8851834  
\$17,328  
Computer Science

#### **"Data Communications Laboratory"**

This project introduces Computer Science students to a laboratory environment where they can master the concepts of data communications.

The equipment in this data communications lab includes four (4) microcomputers that are configured for several network connections: a modem connection and telephone

system simulator that offer typical "dial-up" connections between units; a terminal connection that allows simulation of a computer terminal-host interface; and an Ethernet configuration that provides high speed networking using coaxial cable.

These equipment configurations, along with some special monitoring equipment and software, allow students to gain hands-on experience in data communications. The experiments that students can perform in such an environment can only be carried on in a dedicated laboratory of the type developed for this project.

This award is being matched by an equal sum from the grantee.

Hayden S. Porter, Jr.  
Furman University  
Greenville, SC

USE 8851837  
\$23,208  
Computer Science

#### **"Adding Fourth Generation Language and Real-time Concepts to an Introductory Computer Science Course"**

This project introduces bold changes to the introductory-level Computer Science course at this institution, a course patterned on the recommendations of the ACM Curriculum '78 guidelines. Unlike traditional courses that concentrate almost entirely on the teaching of a third-generation programming language, the new course first has the students solve complex problems using fourth-generation application specific languages. They then progress through database and graphics concepts utilizing a real-time data acquisition laboratory experience. The course includes the teaching of a third generation programming language but comprehensive user-friendly tools drastically shorten the time needed for students to achieve a high level of programming proficiency.

The laboratory environment that supports this project includes: MAC II workstations, connected by AppleTalk local area network software and hardware, a dedicated MAC II fileserver, an Imagewriter LQ printer, and, instrument interfaces to connect the configuration to digitizers, A/D-D/A converters, graphic printers and plotters.

Students in this course achieve a broader understanding of the capabilities of computers and gain valuable experience in exercising these insights on problems of a more useful and realistic scale than is possible in most introductory courses.

This award is being matched by an equal sum from the grantee.



Larry Menninga  
Western Washington Univ  
Bellingham, WA

USE 8852080  
\$16,165  
Computer Science

#### **"Computer Support for Real-time Programming Instruction"**

This project supports enhancement of the Computer Science course in real-time and system level software development. Undergraduate students are exposed to a laboratory having dedicated machines (so that system level errors during software development do not disrupt other users) and high-level software development support and modern interfacing equipment so that practical projects can be carried out in the lab. The equipment supporting this lab includes: VME-bus based microcomputers with serial and parallel ports, floppy disk controller, disk drive and interrupt capabilities; debug monitor; and, cross-assembler.

This award is being matched by an equal sum from the grantee.

Thomas L. Naps  
Lawrence University  
Appleton, WI

USE 8851781  
\$35,043  
Computer Science

#### **"Algorithm Visualization Laboratory"**

This project utilizes a laboratory with graphics capabilities to display the effects of algorithms on data structures. Using animation, data structures are displayed as they are manipulated by algorithms so that students may understand the data structures and algorithms from a conceptual level apart from their representation in a particular language.

The algorithm visualization laboratory has six (6) Macintosh II microcomputers participating in a local Appletalk network. One of the six systems serves as a gateway to an

Ethernet network linking the Macintosh II's to the University's VAX 11-780 and MicroVAX. Most algorithm software development is done on the MicroVAX and then transmitted to the Macintosh computers for graphic display. The lab uses an overhead projection system capable of presenting an interactive Macintosh session on a large screen.

Real-time display allows the instructor to demonstrate concepts of algorithm performance and it allows students to experiment with algorithms and data structures on an individual basis—they learn about algorithms by watching them perform.

This award is being matched by an equal sum from the grantee.

Timothy V. Fossum  
University of Wisconsin  
Kenosha, WI

USE 8852826  
\$30,225  
Computer Science

#### **"Microcomputer Networks/Operating Systems Laboratory"**

This project incorporates an integrated microcomputer systems development configuration into an operating systems laboratory. The laboratory is used to teach implementation-oriented courses in Introductory Operating Systems, Advanced Operating Systems and Networks.

The equipment that supports this project includes nine Zenith microcomputer systems, three printers, and network hardware to connect to an existing VAX computer system.

The project provides students with practical knowledge and experience with operating systems and computer networks, skills that prepare students to function effectively as systems software engineers.

This award is being matched by an equal sum from the grantee.

## **EARTH SCIENCES**

Wayne C. Isphording  
Univ of South Alabama  
Mobile, AL

USE 8852952  
\$46,000  
Geology

#### **"Organic and Inorganic Compounds in Marine and Transitional Marine Environments: A Training Experience for Undergraduate Science Majors"**

The grantee institution is installing an automated X-ray diffractometer to be used to improve instruction in the analytical methods course for geology, biology, and chemistry students. In addition to being used to train students in the methods of solid state organic and inorganic phase analysis, the equipment is to be used by advanced under-

graduate students to carry out research projects in environmental science.

The grantee will match the NSF grant with an equal amount of funds plus 4%.

Steven M. Day  
San Diego State University  
San Diego, CA

USE 8852606  
\$12,495  
Geology

#### **"A Twelve-Channel Seismograph for Field Work in Undergraduate Geophysics"**

This project strengthens undergraduate instruction in geophysics, and creates research opportunities for under-

graduates through the acquisition of a portable exploration seismograph. The instrument is an EG&G Geometrics Model ES-1225 twelve channel exploration seismograph. This unit, which has modern microprocessor technology and digital signal enhancement capability, replaces a 15-year-old single channel seismograph.

The new instrument is used in four undergraduate geophysics courses to teach basic principles of data acquisition in seismic exploration; use of computer software for playback, analysis and interpretation of seismic data; and concepts of digital recording, filtering, and signal enhancement. The unit is also used by undergraduates for senior thesis research in geophysics, hydrogeology, and engineering geology.

This award matched by an equal amount of non-federal funds.

|                 |             |
|-----------------|-------------|
| Helen B. Hay    | USE 8851514 |
| Earlham College | \$8,700     |
| Richmond, IN    | Geology     |

#### **"Instrumentation for Undergraduate Projects in Seismology"**

The equipment funded by this award includes a 12-channel seismograph which is used for student research on depth to bedrock under the surficial glacial deposits in Wayne County, Indiana. This affords geology students the opportunity to learn shallow seismic reflection techniques while carrying out significant research projects. The equipment is also used in a new course on geophysics.

The grantee matching the NSF award with an equal amount of funds.

|                  |             |
|------------------|-------------|
| Paul Karabinos   | USE 8852375 |
| Williams College | \$16,898    |
| Williamstown, MA | Geology     |

#### **"Instrumentation for Mineral Separation and U-Pb Geochemistry Laboratories for Undergraduates"**

This institution is establishing mineral separation and uranium-lead geochemistry laboratories. These laboratories used for undergraduate research projects in geochronology, and to improve instruction in several undergraduate Geology courses. The mineral separation equipment is used to concentrate heavy minerals from sediments and sedimentary rock and to isolate fossils in courses in geomorphology, paleontology, and sedimentology. Together with the equipment for carrying out U-Pb geochemistry it is used in courses in tectonics and geochronology to illustrate the principles of isotopic dating.

The NSF award is being matched by an equal amount from the grantee. In addition, the grantee is providing ad-

ditional funds for building renovation to accommodate the new equipment.

|                          |             |
|--------------------------|-------------|
| Cecil S. Keen            | USE 8852174 |
| Mankato State University | \$34,299    |
| Mankato, MN              | Atmospheric |

#### **"Improvement of the Undergraduate Atmospheric Science Curriculum in Geography with Equipment for Real-Time Meteorology"**

This award funded the purchase of equipment to use satellite imagery, weather radar data, National Weather Service information, lightning strike data, and local weather data to enhance instruction in several undergraduate courses. These include both large introductory courses in physical geography and weather; and more specialized courses in climatology, advanced weather analysis and remote sensing. Students have the opportunity to engage in a number of "hands-on" projects that utilize data obtained with this equipment. The lower division courses serve significant numbers of K-12 teacher candidates.

The grantee is matching the NSF equipment award with an equal amount of funds.

|                                |             |
|--------------------------------|-------------|
| John L. Sonderegger            | USE 8852350 |
| Montana College of             | \$41,610    |
| Mineral Science and Technology | Geology     |
| Butte, MT.                     |             |

#### **"Field Equipment for Undergraduate Hydrogeological Program"**

This award supports the purchase of a data logger, six water level recorders and logger, a well monitoring system, a water quality monitor, a ground water flow meter, eight conductivity meters, a generator, a stratigraphic gamma probe, a normal resistivity probe, two wellhead temperature probes, a permeameter, two air-lift samplers, a gas chromatograph and an organic vapor detector. This equipment is used to improve instruction in a summer field course in Hydrogeology. Students receive "hands-on" training in well construction, aquifer testing, well development, and water quality monitoring.

The grantee matching the NSF award with an equal amount of funds, and also will provide funds for well drilling and construction.

|                             |             |
|-----------------------------|-------------|
| James F. Olmsted            | USE 8853026 |
| SUNY College at Plattsburgh | \$13,872    |
| Plattsburgh, NY             | Geology     |

#### **"Automation and Modernization of an X-Ray Diffractometer for Undergraduate Environmental Geology and Hydrology"**

This award supports the purchase of equipment and software to automate and upgrade an existing manual X-Ray

Diffractometer. A microprocessor controller, diffracted beam monochromator, microcomputer, control and data collection software, minerals database, and search/match software permit fully automated collection and analysis of X-ray data. The upgraded facility is used to improve instruction in courses in X-Ray Crystallography, X-Ray Analysis, Water Quality Analysis, and Soil Analysis. In addition, the upgraded X-Ray Diffractometer is used by undergraduate students in independent research projects.

The grantee is matching the NSF grant with an equal amount of funds.

|                                      |             |
|--------------------------------------|-------------|
| Theodore J. Skaar                    | USE 8851930 |
| SUNY Ulster County Community College | \$32,500    |
| Stone Ridge, NY                      | Geology     |

**"Introduction of Inductively Coupled Plasma Technology to a Community College Water Quality Monitoring Program"**

This award permits the installation of an inductively coupled plasma spectrometer and automatic sample changer. This equipment is used to improve instruction in the water quality monitoring program. Students who are training to become water quality monitoring technicians are introduced to the type of instrumentation that is used by commercial and governmental laboratories to monitor for trace pollutants in water supplies.

The grantee is matching the NSF award with an equal amount of funds.

|                           |             |
|---------------------------|-------------|
| R. P. Sinha               | USE 8851190 |
| Elizabeth City State Univ | \$5,551     |
| Elizabeth City, NC        | Geology     |

**"Dual Polarizing Microscopy for Undergraduate Teaching Program"**

This award to the Department of Geosciences permits the installation of a dual ocular polarizing microscope with television monitor and ancillary equipment. This instrument is used primarily to improve instruction in three upper-division Geology courses: Mineralogy, Optical Mineralogy, and Petrology. It allows instructors to demonstrate the properties of both coarse and fine grained mineral specimens to the classes. It also allows the instructor and student to observe specimens simultaneously to ensure that the student correctly interprets the various features of the specimens.

The grantee institution is one of three historically black institutions offering an undergraduate degree in Geology. The NSF award is being matched by an equivalent amount from the grantee.

|                           |             |
|---------------------------|-------------|
| Yin S. Soong              | USE 8851450 |
| Millersville Univ of Penn | \$6,390     |
| Millersville, PA          | Geology     |

**"Magnetic Tape Module for Processing and Archiving Satellite Image Data for Undergraduate Laboratories Using Earth Resources Data Satellite Images"**

With this award, the grantee institution purchased a 6250 bpi tape drive and associated software. This equipment is used to upgrade courses in Meteorology, Oceanography, and Geology. With the equipment students are able to read in Landsat and NOAA polar orbiting satellite data from standard magnetic tape to an existing Earth Resources Data Analysis System (ERDAS). They then are able to archive processed images from ERDAS on tape for later analysis. Likewise students use the tape system to capture sequences of weather satellite images for analysis.

The grantee is matching the NSF award with an equal amount of funds.

|                        |             |
|------------------------|-------------|
| Frank W. Fletcher      | USE 8851365 |
| Susquehanna University | \$6,850     |
| Selinsgrove, PA        | Geology     |

**"An Electromagnetic Conductivity Meter for Undergraduate Laboratories in Groundwater Resource and Contamination Evaluation"**

This project provided for purchase of an electromagnetic conductivity meter and data digitizer which is being used to improve instruction in courses in Geohydrology. Students carry out extended projects in groundwater resource evaluation and measurements of groundwater contamination. The instrumentation is also being used in research projects by advanced undergraduates for Senior theses.

The grantee is matching the NSF award with an equal amount of funds.

|                     |             |
|---------------------|-------------|
| Alan P. Morris      | USE 8853208 |
| University of Texas | \$26,697    |
| San Antonio, TX     | Geology     |

**"A Microcomputer Facility for Teaching Quantitative Methods in Structural Geology"**

This project provides for purchase of a local-area computer network consisting of a central file-server, seven high-resolution graphics workstations, and peripheral equipment. This system is used to provide computer-based instruction in Structural Geology. This equipment also is used in other Geology courses, and for independent research



projects by advanced undergraduate students. The structural geology component employs a software package developed at UT, San Antonio.

The grantee is matching the NSF award with an equal amount of funds.

Glen C. Gustafson  
James Madison University  
Harrisonburg, VA

USE 8851274  
\$24,308  
Geology

#### **"Modernizing the Geography Laboratory Experience with ERDAS"**

The project provides for purchase of an 80386-based computer workstation, ERDAS satellite imaging hardware and software, and associated computer peripherals. This equipment is used to improve instruction in lower- and upper-division Geography courses. Students are trained in the use of modern digital imaging techniques in remote sensing. In addition, advanced undergraduate students use the equipment for special projects.

The grantee matching the NSF equipment award with an equal amount of funds, and is providing additional support for faculty training.

Richard C. Stenstrom  
Beloit College  
Beloit, WI

USE 8852835  
\$20,650  
Geology

#### **"Rock and Mineral Sample Preparation for Chemical and Microscopic Analysis"**

The grantee purchased sample preparation equipment for use in undergraduate Geology laboratory courses. This equipment is used by Geology students for courses in Crystallography, Mineralogy, Petrography, Petrology, and Sedimentology to prepare samples for a variety of analyses requiring a high degree of sample purity. Advanced undergraduates also use the equipment for similar purposes in senior thesis work and independent projects.

The grantee is matching the NSF equipment grant with an equal amount of funds.

Robert L. Hooper  
University of Wisconsin  
Eau Claire, WI

USE 8851615  
\$45,958  
Geology

#### **"Acquisition of an X-ray Diffractometer for Undergraduate Student Use"**

The grantee purchased an automated X-ray diffractometer, associated apparatus, and a computer for control of

the instrument and analysis of the data. This equipment is used to improve instruction in Introductory and Advanced Geology courses. In two lower-division courses X-ray diffraction techniques are used for instruction in scientific methods and computer-assisted data reduction. In upper-division courses in Mineralogy and Geochemistry this equipment is used to teach basic techniques of X-ray diffraction analysis.

The grantee is matching the NSF award with an equal amount of funds.

John H. Karl  
University of Wisconsin  
Oshkosh, WI

USE 8852033  
\$22,437  
Geology

#### **"An Integrated Instrumentation Package for Undergraduate Seismology"**

The grantee purchased a 24-channel digital floating point seismograph, and an associated microcomputer. This instrumentation is used to improve instruction in undergraduate courses in Geophysics, Geological Exploration, Engineering Geology, Hydrology, and Environmental Geoscience by introducing students to the use of seismic techniques in these areas. In addition the instruments are used for independent projects by undergraduate students. This project involves a collaborative effort between the physics department and geology department at UW, Oshkosh.

The NSF equipment grant is being matched by an equal contribution by the grantee, plus an additional 39% in summer salary support.

Thomas Detwyler  
University of Wisconsin  
Stevens Point, WI

USE 8852094  
\$41,140  
Geology

#### **"An Interactive Videodisc Laboratory for Teaching Introductory Undergraduate Earth Sciences"**

The grantee purchased 12 interactive video disc learning stations and an image capture/processing system. The learning stations are used to improve laboratory instruction in four introductory Geography and Geology courses serving approximately 5,000 students per year. Interactive video disc technology is used to complement conventional instruction by providing tutorials, exercises, simulated field trips, modelling, slow-and accelerated-motion studies, etc. Both existing and newly authored materials are being used. The image capture/processing system is used to prepare new video disc materials. The project builds on substantial pilot work carried out by the project director.

The grantee is matching the NSF award with an equal amount of funds.

## ENGINEERING

Francis M. Donovan, Jr.  
Univ of South Alabama  
Mobile, AL

USE 8852321  
\$34,992  
Engineering-Mechanical

Archie G. Lambert  
Arkansas Tech University  
Russellville, AR

USE 8851291  
\$53,238  
Engineering-Electrical

### "Undergraduate Controls Laboratory"

This project extends the use of an existing instrumentation laboratory by incorporating programmable control capability. The major items of equipment are eight programmable controllers with the necessary computers and software. A number of transducers and associated equipment are also used in this lab.

The equipment is used by engineering juniors and seniors to study experimental aspects of automatic control. They experiment with control of processes and machines without having to become involved with undue circuit design and construction. These students gain proficiency in an area of engineering which is in increasing demand in today's industry.

This award is being matched by an equal sum from the grantee.

Edmund Tsang  
Univ of South Alabama  
Mobile, AL

USE 8851334  
\$8,445  
Engineering-Materials

### "Undergraduate Metallurgy Laboratory Improvement"

This project provides hands-on experience for undergraduate mechanical engineering students on modern corrosion testing and measurement equipment. The equipment funded for this laboratory enhancement includes: a potentiostat, a corrosion cell, interface for a PC, and corrosion-analysis software. This equipment is used to measure corrosion current and corrosion potential of common engineering materials in different service environments and to study the electrochemical principles of corrosion.

The project is significant because the equipment serves as a teaching tool to give junior-level students experience with corrosion principles and it builds on experience with modern instrumentation that students have acquired in sophomore-level course.

This award is being matched by an equal sum from the grantee.

### "Sixteen Bit Digital Systems Laboratory"

This project supports the expansion of this institution's digital design laboratory to include sixteen-bit computer architecture. Using this laboratory, undergraduates write programs in high-level, assembly and machine languages, they experiment with serial and parallel communications and interrupts, and, they synthesize and monitor control programs for motors, robots and other devices. The equipment that supports this laboratory includes: in-circuit emulators, INTEL SDK-86 computers, PC-based development systems and associated software.

This award is being matched by an equal sum from the grantee.

Ahand K. Ojha  
University of Arkansas  
Little Rock, AR

USE 8852178  
\$24,300  
Engineering-Electrical

### "Modernization of Electronic Communication Laboratory"

To meet the growing demand of the communications industry, this institution has developed an emphasis on digital and fiber optic communication in the undergraduate curriculum of the Electronics Technology Program. This project provides six substations for experiments in data and fiber optic communication, and telephone networking techniques. The major equipment acquired under this project include six sets of fiber optic measurement systems, six digital communication experiment boards, two computer-controlled telephone exchanges, and two Zenith, Z-248 personal computers. The availability of this equipment allows the electronics technology students to reinforce theoretical concepts with hands-on laboratory experience in digital and fiber optic communication and telephone networking technology.

This award is being matched by an equal sum from the grantee.

|                            |                        |
|----------------------------|------------------------|
| K. N. Balasubramanian      | USE 8851167            |
| California Poly State Univ | \$18,400               |
| San Luis Obispo, CA        | Engineering-Mechanical |

#### **"Development of A Pneumatic Automation Simulator"**

A Pneumatic Automation Simulator is being developed, using pneumatic and electro-pneumatic elements, in the Industrial Engineering Laboratory at this institution. The simulator is used primarily in the manufacturing-oriented engineering courses. It provides practical instruction to students in the design, test, and microcomputer control of pneumatic circuits that generate several of the automation functions used in manufacturing methods and assembly systems. The most common functions in the circuit designs are work clamping, release and/or ejection, orientation, work sequencing and delay. This instructional facility also acts as an independent setup for student projects and attracts industry collaboration with the institution in the continuing education of their engineers in the use of pneumatic automation systems.

This award is being matched by an equal sum from the grantee.

|                            |                       |
|----------------------------|-----------------------|
| Daniel W. Walsh            | USE 8853028           |
| California Poly State Univ | \$100,000             |
| San Luis Obispo, CA        | Engineering-Materials |

#### **"Undergraduate Nondestructive Evaluation Facility"**

This project expands this institution's already existing materials program to include state-of-the-art nondestructive evaluation of materials and manufactured components. The equipment incorporated into the lab includes: a scanning laser acoustic microscope, acoustic emission analysis system, image analysis system and eddy current test device. These computer interfaced devices are used to evaluate both metallic and non-metallic materials.

Students using the enhanced materials laboratory are able to experiment with: material identification, flaw detection, flaw size determination, semiconductor continuity, sintering efficiency, debonding of composites, fatigue crack propagation, martensitic transformations, weld flaw detection and characterization of hydrogen damage.

This award is being matched by an equal sum from the grantee.

|                            |                        |
|----------------------------|------------------------|
| Michael T. Wollman         | USE 8852014            |
| California Poly State Univ | \$45,903               |
| San Luis Obispo, CA        | Engineering-Electrical |

#### **"Advanced Electro-Optics Laboratory"**

This project introduces undergraduates to some advanced topics in fiber optics. The fiber optics laboratory

supported by this grant builds on an already existing laboratory that was funded by industry. The enhanced laboratory permits students to study modern optical fibers and connection techniques. A new course, supported by this laboratory, permits students to investigate optical signal processing techniques and components.

The primary equipment that supports this laboratory includes: laser diode drivers, HP pulse and function generators, fiber optic receivers and power supplies, electro-optic modulator with driver, and a collection of lasers and equipment accessories.

This award is being matched by an equal sum from the grantee.

|                            |                   |
|----------------------------|-------------------|
| D. Stafford Woolard        | USE 8851511       |
| California Poly State Univ | \$14,605          |
| San Luis Obispo, CA        | Engineering-Civil |

#### **"Environmental Experimentation Laboratory"**

This project permits undergraduate students to experiment with the effects of variations in heat, sound and light on human senses. This experience prepares these students to incorporate environmental concepts into the building design process. The equipment used to support this project includes: temperature sensors, thermal monitoring system, thermographs, thermohygrographs, heat pump demonstrator, photometer and a light demonstration box along with a microcomputer and environmental software.

This award is being matched by an equal sum from the grantee.

|                             |                   |
|-----------------------------|-------------------|
| Riadh Munjy                 | USE 8852157       |
| California State University | \$51,000          |
| Fresno, CA                  | Engineering-Civil |

#### **"Computer Aided Mapping"**

This project permits surveying engineering students to have a laboratory experience of applying photogrammetric methods to computer aided mapping and geographic information systems. The project laboratory includes a fast, versatile computer aided analytical stereoplottter. With this equipment, students experiment with stereo models and with generating and manipulating digital terrain data bases. In combination with other existing equipment, advanced students monitor structural deformations, measure underwater structures and analyze human body and joint movements for bioengineering studies.

This award is being matched by an equal sum from the grantee.



J. Dario Aristizabal-Ochoa  
D. V. Ramsamooj  
California State Univ  
Fullerton, CA

USE 8852994  
\$10,544  
Engineering-Civil

#### **"Enhanced Earthquake Simulator"**

This project upgrades an already existing laboratory for earthquake study. The laboratory improvement includes the addition of a controller that adds the capability of simulating a real earthquake on a shaking table. The improvement of the earthquake lab permits students to study structures and their behavior under real earthquake conditions. The major piece of equipment supported by this award is an MTS Systems 469.11 three-variable controller.

This award is being matched by an equal sum from the grantee.

Anjan K. Bhaumik  
California State Univ  
Los Angeles, CA

USE 8851914  
\$30,550  
Engineering-Civil

#### **"Universal Testing Machine for Materials Testing Laboratory"**

This project introduces computer assisted testing of materials into the Civil and Mechanical Engineering curricula at this institution. The laboratory that supports this project includes a Tinius Olsen Universal Testing Machine with an integrated microcomputer. This equipment not only permits students to carry on many experiments in a given lab period, but, because of the automated data acquisition and display capabilities of the equipment, students gain a greater intuitive feel for the behavior of materials.

This award is being matched by an equal sum from the grantee.

Phillip I. Gold  
California State Univ  
Los Angeles, CA

USE 8851329  
\$11,317  
Engineering-Mechanical

#### **"A Cogeneration Instrumentation Laboratory"**

This project permits undergraduate mechanical engineering students to carry on experiments on a small-scale cogeneration system that is instrumented and interfaced to a data acquisition system. Student experiments and projects involve both thermodynamic and economic evaluation of cogeneration concepts. They also learn about techniques of computer assisted data acquisition in a laboratory environment.

This award is being matched by an equal sum from the grantee.

Joan Al-Kazily  
California State University  
Sacramento, CA

USE 8851278  
\$6,650  
Engineering-Civil

#### **"Traffic Data Acquisition and Analysis Laboratory"**

This project supports the enhancement of the teaching of Transportation Engineering at this institution. Computers are integrated into two undergraduate courses covering transportation facility design and operation and transportation systems planning and management. The project makes electronic data acquisition equipment and data analysis software available to undergraduate students for use in class assignments and projects. The equipment made available for this project includes traffic counting equipment and software, turning movement counter, and in-motion data collection system.

This award is being matched by an equal sum from the grantee.

James G. Simes  
California State University  
Sacramento, CA

USE 8851141  
\$50,000  
Engineering-Electrical

#### **"General Purpose Instrumentation Bus Laboratory"**

This project provides eight (8) General Purpose Instrumentation Bus (GPIB) equipped laboratory stations for undergraduate students in this institution's electrical and electronics engineering program. The stations are used in the first junior-level circuits lab and the first junior-level electronics lab. Each station consists of a triple power supply, a function generator, a digital voltmeter, an oscilloscope, a multiplexing switch, a GPIB controller and a printer. This laboratory configuration permits major revisions in the curriculum impacted by the lab, revisions that take advantage of the changes in technology represented by this lab setup.

This award is being matched by an equal sum from the grantee.

Joseph Katz  
Nagy S. Nosseir  
San Diego State University  
San Diego, CA

USE 8851535  
\$47,615  
Engineering-Mechanical

#### **"Data Acquisition System for Wind-Tunnel Laboratories."**

The wind-tunnel laboratories used in this institution's Aerospace Engineering program are updated and improved, exposing students to modern computer-aided wind-tunnel technology. A mini-computer, with graphic capabilities, is

interfaced to the wind-tunnels so that students can carry on experiments using real-time data acquisition and analysis. This modernization of equipment and analytic techniques exposes students to laboratory computer technology, enhances the study of experimental/analytical fluid dynamics and better prepares students for the aerospace industry and graduate study.

This award is being matched by an equal sum from the grantee.

David M. Perkins  
Univ of Southern Colorado  
Pueblo, CO

USE 8851248  
\$36,536  
Engineering-Electrical

#### **"A VLSI Digital Design Laboratory"**

This project permits technology students to study Very Large Scale Integrated (VLSI) circuits using programmable gate array technology. Since programmable gate array devices do not require customized manufacturing, the need for long design cycles and costly integrated circuit fabrication facilities are eliminated. These features make it possible for students to perfect complicated designs in little time at small expense.

The laboratory supporting this project includes the Xilinx development system, simulator and emulator running on a collection of eight PC's.

This award is being matched by an equal sum from the grantee.

Preston A. White, III  
Southern College of Technology  
Marietta, GA

USE 8851403  
\$87,173  
Engineering-Electrical

#### **"Automated Antenna Analysis Laboratory"**

This project exposes students to an Automated Antenna Analysis Laboratory (AAAL); a computer-driven test and measurement system equivalent to that used in the Communications industry. Students using the AAAL study in great detail the performance of virtually all types of antennas including satellite dishes, mobile antennas and complex arrays. Using the AAAL equipment, students verify the performance of their antenna designs while learning the characteristics of automated-test systems. This laboratory also serves as a regional resource to other Technical Institutions in the area.

This award is being matched by an equal sum from the grantee.

D.Paul Mehta  
Bradley University  
Peoria, IL

USE 8853102  
\$23,573  
Engineering-Mechanical

#### **"Implementation of A Modern Data Acquisition System"**

This project supports development of a microprocessor-based and computer-interfaced data acquisition system for the undergraduate Mechanical Engineering laboratory. In addition to data generated in the laboratory, the students will also have the capability to acquire real world data through remote sensing. Sensors are installed in the field for the measurement of temperatures, pressures, flows, volt-amperes, strains, and mechanical vibrations on a mechanical system. The signals from the sensors are transmitted to the data acquisition laboratory via telephone lines. This provides the students opportunities for "hands on" experience with telecommunications in the acquisition, storage, retrieval, and analysis of data. Implementation of the undergraduate instrumentation laboratory at this institution enables the faculty to respond to the revolutionary effects of digital technology in mechanical engineering education.

This award is being matched by an equal sum from the grantee.

Iqbal Shareef  
Bradley University  
Peoria, IL

USE 8853061  
\$41,000  
Engineering-Other

#### **"A Model Laboratory for Material Removal Processes"**

This project permits undergraduate students to gain experience with a modern material-removal processes laboratory. The laboratory experiments include topics ranging from measurement of accuracy of a machined part to measurement of surface finish, cutting forces, tool wear-temperature/chatter. The techniques employed to measure these variables include: measurement of forces using active systems such as quartz dynamometers, measurement of temperature using thermocouples, and measurement of wear from acoustic signals. The major equipment supporting this lab includes: profilometer, piezoelectric load cell, a CNC mill, a signal analyzer, an acoustic emission transducer and a data acquisition system.

This award is being matched by an equal sum from the grantee.

Ronald S. Artigue  
Rose-Hulman Institute of Tech  
Terre Haute, IN

USE 8851780  
\$24,718  
Engineering-Chemical

#### **"Integration of Bioseparations into the Chemical Engineering Curriculum"**

The purpose of this project is to establish laboratory instruction in bioseparations within the chemical engineering undergraduate curriculum.

The laboratory includes bench-scale bioseparation and supporting equipment, including a microcomputer-based data acquisition and control system. This collection of equipment permits students to apply their theoretical knowledge of bioseparation techniques and integrated downstream processing through laboratory experimentation, exposes them to analytical methods and techniques in biochemistry, automates the control and data acquisition of the experiments and familiarizes students with modern computer control and data-logging equipment and techniques.

This award is being matched by an equal sum from the grantee.

Jerry A. Caskey  
Rose-Hulman Institute of Tech  
Terre Haute, IN

USE 8851502  
\$17,934  
Engineering-Chemical

#### **"Polymer Engineering Laboratory Improvement Program"**

This project introduces a state-of-the-art laboratory experience to students whose concentration is in Polymer Engineering. The laboratory equipment (Differential Scanning Calorimeter/Thermogravimetric Analyzer), permits students to study and analyze polymer products that have recently been developed.

This award is being matched by an equal sum from the grantee.

Noel E. Moore  
Rose-Hulman Institute of Tech  
Terre Haute, IN

USE 8851814  
\$12,805  
Engineering-Chemical

#### **"A Multipurpose Process Control Experiment Using Self-Tuning Controllers"**

This project introduces undergraduate chemical engineering students to a multi-purpose process control environment. Modern process control hardware and supporting equipment (including a microcomputer-based data acquisition and control system) significantly improves the undergraduate laboratory experience by: allowing students

to compare conventional control strategies (single analog loops) with examples of modern computer control; exposing students to modern process control hardware (self-tuning controllers) and permitting them to compare equipment provided by several vendors; and acquainting students with state-of-the-art computer control and data-logging equipment and techniques.

This award is being matched by an equal sum from the grantee.

Alan T. Roper  
Rose-Hulman Institute of Tech  
Terre Haute, IN

USE 8851543  
\$41,500  
Engineering-Mechanical

#### **"Aeronautical Instruction Laboratory"**

This project enhances the aeronautical instructional capability at this institution. Students are exposed to the phenomena associated with aeronautical design and analysis through experiments using a highly instrumented wind tunnel. The wind tunnel is sufficiently large to produce flow conditions that allow wings which utilize modern airfoil sections (e.g., NASA General Aviation section) to behave properly and instrumentation of the wind tunnel that causes minimal interference with flow over the models. Students in the aeronautical option who utilize this lab are prepared for industrial careers in the field of Aeronautical Engineering.

This award is being matched by an equal sum from the grantee.

Philip M. Gerhart  
University of Evansville  
Evansville, IN

USE 8851517  
\$30,932  
Engineering-Mechanical

#### **"Student Designed Projects in Measurements and Instrumentation"**

This project supports an innovative curriculum improvement in this institution's undergraduate Mechanical Engineering program. With the equipment funded by this award, students are able to design their own experiments in mechanical measurements and instrumentation, incorporating computer data acquisition and analysis as part of the laboratory experience. The equipment included in the measurements laboratory includes: analog/digital conversion system, data acquisition system, oscilloscopes, flow measurement system, temperature and humidity measurement system, linear displacement system, velocity and acceleration measurement system, rotational, load and torque measurement system.

This award is being matched by an equal sum from the grantee.



Gilbert M. Lehmann  
Valparaiso University  
Valparaiso, IN

USE 8851636  
\$8,860  
Engineering-Mechanical

**"Data Acquisition System for Mechanical Engineering Laboratories"**

This project incorporates data acquisition systems (DAS) into this institution's Mechanical Engineering laboratory. The DAS systems, consisting of four individual workstations, are interfaced to already existing laboratory equipment. Each workstation consists of a personal computer, data acquisition interface, printer, plotter and related software. This equipment assists students with data acquisition, computational analysis, and presentation of results for a variety of laboratory experiments. Students are freed from tedious manual data collection and analysis and focus their energies on the interpretation of results and parameter variations and responses. Students are actively involved in the setup of experiments, the interfacing of transducers, the use of off-the-shelf software, and the development of software for data presentation and analysis.

This award is being matched by an equal sum from the grantee.

Merlyn C. Vocke  
Valparaiso University  
Valparaiso, IN

USE 8851690  
\$44,386  
Engineering-Electrical

**"An Integrated Design, Fabrication, and Radiofrequency Testing Laboratory"**

This project exposes undergraduate students to a laboratory environment where the design, fabrication, and testing of circuits and systems for radiofrequency and microwave applications are linked together.

Students using the laboratory incorporate laboratory experiences into their design process, they gain a realistic view of the value and limitations of analytic models and the methods used to develop the models; they become familiar with industry practices and standards; and they experience the limitations of instruments and measurement techniques.

This award is being matched by an equal sum from the grantee.

Kenneth Mussnug  
Western Kentucky University  
Bowling Green, KY

USE 8852159  
\$23,978  
Engineering-Mechanical

**"Enhancement of a Flexible Manufacturing System."**

This project incorporates a programmable robot into this institution's flexible manufacturing laboratory. The robot,

a GMF S100, permits curriculum enhancements in both the lower and upper divisions. In the lower division, courses on Contemporary Manufacturing Operations include topics requiring entry level programming of the robot. Upper division courses in Computer Aided Manufacturing and the Senior Design Course expose students to advanced device programming and operation. The upper division students utilize the programmable robot to produce products.

This award is being matched by an equal sum from the grantee.

Joseph M. Richardson  
McNeese State University  
Lake Charles, LA

USE 8852893  
\$43,400  
Engineering-Civil

**"Upgrading of the Universal Testing Machine for Undergraduate Civil and Mechanical Engineering"**

This project replaces an antiquated screw-powered Universal Testing Machine (UTM) with a modern UTM that has a capacity of 400,000 lbs. in compression and 200,000 lbs. in tension. The UTM is hydraulically operated which offers more precise control than the mechanically operated screw type. This increased capability makes it easier to control experiments and to improve accuracy when operating in the lower load ranges. The UTM is equipped with accessories which provide the Civil and Mechanical Engineering Departments the capability of testing concrete cylinders in compression, unthreaded rods and reinforcing bars, and flat bar specimens. A flat bed recorder is provided to make hard copy diagrams of stress versus strain for the materials tested. The new UTM is also used in demonstration in the Pre-Freshmen Engineering Program designed to attract minority high school students to the science and engineering fields.

This award is being matched by an equal sum from the grantee.

Amitava Jana  
Southern University A & M College  
Baton Rouge, LA

USE 8853122  
\$23,882  
Engineering-Mechanical

**"Robotics Laboratory Project"**

This project enhances this institution's offerings in the areas of manufacturing, computer-aided design/computer-aided manufacturing (CAD/CAM) and robotics. The equipment funded by this award supports undergraduate Mechanical Engineering courses at the sophomore/junior level as well as advanced courses at the senior level. In particular, students learn both theoretical and practical aspects of: teach pendant control, computer interfacing, mechanical manipulation, off-line programming and simulation, and ap-

plication of computer vision. The laboratory equipment includes: Rhino robots with tilt rotary carousel, belt conveyor, x-y table, software and other accessories, and, a computer vision system. Student interface is via IBM PC's.

This award is being matched by an equal sum from the grantee.

John G. Anderson  
College of the Atlantic  
Bar Harbor, ME

USE 8852860  
\$6,385  
Engineering-Civil

#### **"A Geographic Information System (GIS) for Teaching Environmental Science to Undergraduates"**

This project is establishing a Geographic Information System (GIS) teaching facility that permits students to learn fundamental principles of computerized cartography and spatial data analysis. GIS products including specialized maps and overlays are being used in a variety of classes and teaching situations, both as examples of computer applications and as specific aids in courses in Biogeography and Applied Ecology.

The proposal includes funding for both software and hardware needed in creating and maintaining a geographic database for Mt. Desert Island and its immediate surroundings. Students select specific regions of the island and by digitizing a series of maps containing data ranging from hydrology to current land-use patterns, create a comprehensive picture of the island's biogeography. As the project develops, increasing areas will be covered and the resulting digital model will be available to both the academic and general community as an aid in planning, resource use, and development. The project provides students a unique opportunity to interact with and to learn to apply state-of-the-art cartographic techniques.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Peter H. Anderson  
Morgan State University  
Baltimore, MD

USE 8852176  
\$15,551  
Engineering-Electrical

#### **"Digital Circuits Laboratory"**

This project widens the scope of this institution's Digital Electronics course sequence by including the ability to customize advanced architecture logic circuits and by exposing students to logic analyzers for debugging and troubleshooting complex digital circuits.

This project is supported by a laboratory which includes programmable Logic Workstations running Altera development software and HP Logic Analyzers. This collection

of hardware and software permits students to design and simulate a circuit, using a computer, prior to constructing the circuit.

This award is being matched by an equal sum from the grantee.

David R. Clark  
GMI Engineering and  
Management Institute  
Flint, MI

USE 8851791  
\$13,037  
Engineering-Other

#### **"Computerized Data Acquisition for Human Factors Laboratory"**

This project enhances two undergraduate courses that make use of this institution's existing human factors laboratory. Students using the laboratory experiment with real-time data acquisition in a data-intensive (e.g., 50 to 100 sample/second) environment. Using the data acquisition setup supported by this award, students take many more samples for longer durations than previously possible. The data acquisition system also pre-processes the data from the interfaced human factors devices to give students a greater degree of confidence in their experiments than with manual systems.

The equipment supporting this lab includes networked Apple Macintosh computers (II's and SE's) with A/D interfaces and data acquisition software.

This award is being matched by an equal sum from the grantee.

Huseyin R. Hizioglu  
Bhag S. Guru  
GMI Engineering and  
Management Institute  
Flint, MI

USE 8851806  
\$100,000  
Engineering-Electrical

#### **"A High-Voltage Laboratory"**

This project exposes students to a laboratory environment that supports their studies in high voltage generation and measurement techniques. In addition to validating theoretical concepts, the high voltage laboratory allows students to design, construct and test different types of high voltage generators. It permits hands-on experiences where students observe reactions of particular insulators to high voltages, and it provides an environment where students gain a practical intuitive understanding of some highly theoretical topics.

This award is being matched by a greater than equal sum from the grantee.

|                      |                        |
|----------------------|------------------------|
| Maciej Zgorzelski    | USE 8852179            |
| GMI Engineering and  | \$100,000              |
| Management Institute | Engineering-Mechanical |
| Flint, MI            |                        |

#### **"Computer Integrated Manufacturing Laboratory"**

This project supports a new undergraduate program in Manufacturing Systems Engineering at this institution as well as a capstone course, Computer Integrated Manufacturing (CIM). The new laboratory consists of several pieces of flexible manufacturing equipment (numerically controlled machine tools, robots, automated guided vehicles) and integrated computing equipment. The CIM laboratory is networked to an existing Computer Aided Design System so that students experience a complete production cycle (from product design, to manufacturing, to assembly) in a "factory of the future" computerized environment.

This award is being matched by an equal sum from the grantee.

|                                |                        |
|--------------------------------|------------------------|
| Donald R. Zrudsky              | USE 8851816            |
| University of Minnesota Duluth | \$37,707               |
| Duluth, MN                     | Engineering-Electrical |

#### **"Teaching Programmable Instrumentation Control"**

This project exposes undergraduate students to advanced graphical instrumentation control techniques. The laboratory supporting this project includes Macintosh II computers, special hardware interfaces, Labview (TM) software and a collection of oscilloscopes, function generators, multimeters and other accessories. Using these configurations students carry on instrument control via a user-friendly graphical programming technique, transform data to their exact requirements, and tabularize and graph results in an integrated environment.

This laboratory not only serves students in the existing Computer Engineering Controls Laboratory but also non-computer-majors from the College of Science and Engineering who need to be involved in computer controlled instrumentation and students who wish to carry on projects and independent study in a laboratory environment.

This award is being matched by an equal sum from the grantee.

|                               |                        |
|-------------------------------|------------------------|
| Scott Carpenter               | USE 8852040            |
| Southwest Missouri State Univ | \$72,422               |
| Springfield, MO               | Engineering-Mechanical |

#### **"Drafting Fundamentals—Micro-CAD Laboratory"**

This project supports a state-of-the-art transition in industrial technology education. Using the equipment pur-

chased through this award, students are able to gain expertise in Computer Aided Design and Drafting, migrating from the traditional two-dimensional paper and pencil environment to a three-dimensional dynamic environment. The primary equipment housed in the laboratory includes: Zenith CAD workstations with hard disks, co-processors, and CAD software. The workstations are networked, allowing design interaction and use of a digitizing tablet and printer/plotter.

This award is being matched by an equal sum from the grantee.

|                                    |                   |
|------------------------------------|-------------------|
| Thomas E. Finch                    | USE 8851803       |
| Montana College of Mineral Science | \$48,330          |
| and Technology                     | Engineering-Civil |
| Butte, MT                          |                   |

#### **"Surveying Laboratory Enhancement"**

This project introduces students in this institution's Mining program to state-of-the-art surveying practices. By exposing students to Total Surveying Stations, not only is their surveying experience enhanced, experiments are performed that were not possible before the advent of equipment of the type used in this project. In their field work, students get hands-on experience and retrieve digital data with portable devices. In their laboratory work, students have a collection of software tools whereby they analyze their field data and use graphical programs to display and manipulate collections of their field data.

This award is being matched by an equal sum from the grantee.

|                    |                        |
|--------------------|------------------------|
| Alice A. Saylor    | USE 8852475            |
| Bloomfield College | \$18,213               |
| Bloomfield, NJ     | Engineering-Electrical |

#### **"Laboratory for Applied Scientific Computing"**

This data acquisition and analysis laboratory supports a unique applied scientific computing program at this institution. Students in this program study digital electronics, interfacing, science applications and carry on individual computing projects. In their courses, they gain experience in using off-the-shelf interfacing equipment and software and develop their own versions for data acquisition and instrument control. Because of its simplicity, this lab is also used by other science majors at this institution.

This award is being matched by an equal sum from the grantee.



Devdas Shetty  
Cooper Union  
New York, NY

USE 8852135  
\$60,213  
Engineering-Mechanical

**"Comprehensive Introduction of Computer Aided Engineering, Computer Aided Design and Manufacturing Facilities to the Undergraduate Curriculum in Mechanical Engineering"**

The Mechanical Engineering students at this institution gain enhanced exposure to computer-based engineering systems and to the various stages of design, analysis, drafting, and manufacturing. This project provides an integrated computer-aided design/computer-aided manufacturing software package, precision graphics workstations, and a numerically-controlled vertical milling machine. This instrumentation is used as part of the required design-oriented Mechanical Engineering courses and associated electives. The students learn how to realistically simulate product performance in the initial design stage before committing to detailed drawings and manufacturing. This project creates a real-life computer-oriented design environment for the students and makes available a basic educational tool for general use in other disciplines.

This award is being matched by an equal sum from the grantee.

Lynn Fuller  
Rochester Institute of Tech  
Rochester, NY

USE 8852823  
\$41,076  
Engineering-Electrical

**"Thermal Design of Integrated Circuits"**

This project allows students in the Microelectronics Program to apply thermal imaging to the design of integrated circuits.

The laboratory that supports this project includes a Mikron Thermal Tracer which students use to measure and display thermal performance of integrated circuits which have been designed and fabricated in the Microelectronics Laboratory. This activity permits students to gain practical insight into the design and fabrication problems associated with integrated circuits.

In addition to its primary use in the Microelectronics Lab, the thermal tracer system is used by mechanical engineering students in analyzing fluid and heat transfer systems.

This award is being matched by an equal sum from the grantee.

Mark Kempinski  
Rochester Institute of Tech  
Rochester, NY

USE 8852420  
\$29,499  
Engineering-Mechanical

**"Development of an Undergraduate Systems and Control Laboratory"**

This project supports the development of an undergraduate dynamic systems and control laboratory to enhance the sequence of dynamics courses presently offered by the Department of Mechanical Engineering. The laboratory is composed of four workstations equipped with an HP 6253A dual DC power supply, HP 6825A DC power supply/amplifier, motor control module, and digital oscilloscope. Each pair of workstations is serviced by digital and analog pen plotters, and a Wavetek Data Multimeter interfaced to an IBM PS/2-50 computer for data logging, analysis, and digital control capability. The instrumentation allows the student to perform parameter quantification experiments on diverse system attributes such as spring constants, dash-pot damping coefficients, and the torque and generator constants of electric motors.

This award is being matched by an equal sum from the grantee.

Joseph R. Cristina, Jr.  
SUNY Erie Community College  
Williamsville, NY

USE 8852002  
\$50,208  
Engineering-Mechanical

**"Acquisition of Computer Aided Drafting (CAD) Equipment"**

The Civil Engineering Technology Unit at this institution is acquiring new hardware and software for their Computer Aided Drafting (CAD) Laboratory to teach a generic approach to CAD. The special objective of this project is to teach disabled students, with limited mobility, the necessary drafting skills required in conventional drafting courses. In equipping the laboratory with 16 workstations consisting of an IBM PS/2 Model 50 computer, a color display monitor, a graphics tablet and mouse, AUTOCAD software and access to an HP Plotter, the disabled students are offered training on an advanced, industrial CAD system. The success of this project will potentially create new educational opportunities for the disabled.

This award is being matched by an equal sum from the grantee.

Constantine Yapijakis  
The Cooper Union School Eng  
New York, NY

USE 8852336  
\$35,325  
Engineering-Civil

**"Environmental Engineering Laboratory"**

This project permits undergraduate students to carry on experiments and individual research projects with an Up-

flow Pack-Bed Bioreactor. The pilot unit in this laboratory is used in conjunction with mutant bacteria cultures to study the effectiveness and kinetics of the aerobic fixed-film, submerged bed process in treating industrial and/or toxic wastewaters. The instruments funded with this award are necessary for monitoring the various parameters of the process and for analyzing various quality parameters in the raw and treated waste. The laboratory equipment includes: TOC Analyzer with accessories; TOD Analyzer with accessories; dissolved oxygen meters; COD test systems, BOD standard test units; spectrometer; binocular microscope; muffle furnace; glass still; total suspended solids analyzer; turbidimeter; balance; temperature logger; aspirator pump; and, other accessories.

This award is being matched by an equal sum from the grantee.

R. Janardhanam  
University of North Carolina  
Charlotte, NC

USE 8852316  
\$40,225  
Engineering-Civil

#### **"Comprehensive Geotechnical Engineering Laboratory."**

This project exposes Civil Engineering students to a comprehensive geotechnical engineering laboratory that integrates computers into laboratory experiments. The computer integration involves real-time data acquisition from and control of a collection of instruments. The lab equipment includes: pressure permeater, temperature controlled freezing and thawing chamber, extensometer, cyclic triaxial cell, interfaced microcomputer and various sensors and transducers.

This laboratory not only enhances existing experiments in Geotechnical Engineering but also permits students to carry on studies in new areas such as: examining the migration of pollutants through soils and performing 3-D testing of soils.

This award is being matched by an equal sum from the grantee.

Edgar G. Munday  
University of North Carolina  
Charlotte, NC

USE 8852841  
\$6,750  
Engineering-Mechanical

#### **"Microprocessor Interfacing for Undergraduates in Mechanical Engineering"**

This project introduces undergraduate Mechanical Engineering students to microprocessor interfacing. The student's skills for designing experiments are enhanced by the ability to interface the microprocessor to basic engineering sensors and components such as strain gages, thermocou-

ples, LVDT's and stepping motors. The laboratory equipment that supports this project consists of microprocessor trainers, analog interfaces and associated software.

This laboratory familiarizes students with modern techniques of measurement.

This award is being matched by an equal sum from the grantee.

Don Phillips  
Cameron University  
Lawton, OK

USE 8852254  
\$50,600  
Engineering-Mechanical

#### **"Engineering Technology Instrumentation Laboratory Improvement"**

This project supports the Engineering Technology program at this institution by enhancing the instrumentation laboratory. Previously existing CAD equipment is linked to compatible pneumatic and hydraulic test equipment so that students experience state-of-the-art industrial instrumentation and feedback control systems. The lab improvement is achieved through the acquisition of Festo Pneumatic and Hydraulic trainer packages; FESTO Programmable Controller; and NIDA Rotating Machinery and Synchro/Servo training packages.

This award is being matched by an equal sum from the grantee.

John M. Yarbrough  
Omar Zia  
Oregon Institute of  
Technology  
Klamath Falls, OR

USE 8851227  
\$37,816  
Engineering-Electrical

#### **"Analog Circuit Instruction Improvement"**

This project enhances the curriculum of an Electrical Engineering Technology Program by providing a laboratory environment for the study of analog circuits using computer aided engineering techniques.

The laboratory equipment includes Rapid Systems spectrum analyzer/digital storage oscilloscopes connected to personal computers. These systems provide significant spectral analysis digital sampling capability at low cost. Students using the laboratory are able for example, to sample transients, save waveforms and later compare these to new waveforms.

This award is being matched by an equal sum from the grantee.

Mohamed A. El-Sharkawy  
Bucknell University  
Lewisburg, PA

USE 8851208  
\$12,659  
Engineering-Electrical

#### **"Real Time Signal Processing Laboratory"**

This project develops a signal processing laboratory equipped with the necessary hardware and software to

analyze speech and music signals and conduct other signal processing experiments. Using the PC based Tektronix TMS320, Signal Processing Microcomputer, students design digital filters, compare the performance of different design methods, and implement digital filter designs in machine language code. The students also program the TMS320 for other digital signal processing applications, such as Fast Fourier Transforms, real time spectral analysis and speech and music analysis and synthesis.

This award is being matched by an equal sum from the grantee.

|                                   |                        |
|-----------------------------------|------------------------|
| Richard Ciocci                    | USE 8852855            |
| Harrisburg Area Community College | \$98,394               |
| Harrisburg, PA                    | Engineering-Mechanical |

#### **"CAD/CAM Manufacturing and Automated Processing Laboratory"**

This project supports the Mechanical Engineering Technology program and a new program in Manufacturing and Design. Students of manufacturing and design, mechanical, industrial automation and electronic engineering technology study the concepts and techniques of computer-integrated processing and the interfacing necessary for computer-assisted functions. Utilizing workcells, students experiment with production operations in the laboratory. The laboratory supporting this project includes the following equipment: three CNC machine tools (one mill and two lathes) linked to the CADAM system for CAD/CAM production, integrated with robots, microprocessors and programmable logic controllers. Manufacturing precision is verified with an optical comparator and manual gages. Students are trained as technologists in this state-of-the-art laboratory to serve a critical need in the Nation.

This award is matched by an equal amount from this institution.

|                    |                        |
|--------------------|------------------------|
| Faruq M. Siddiqui  | USE 8851669            |
| Swarthmore College | \$14,132               |
| Swarthmore, PA     | Engineering-Mechanical |

#### **"Enhanced Engineering Materials-Evaluation Laboratory"**

This project enhances the existing materials laboratory by incorporating: a PC-based multi-channel stress-strain-temperature data acquisition and display system that permits more insightful student analysis of material response to static and low-frequency dynamic loading; and, integrating a CCTV display system with an inverted metallograph and other optical equipment, permitting classroom demonstration and group laboratory examination of microstructures and fracture surfaces.

This award is being matched by an equal sum from the grantee.

|                        |                        |
|------------------------|------------------------|
| Rulph Chassaing        | USE 8851147            |
| Roger Williams College | \$26,950               |
| Bristol, RI            | Engineering-Electrical |

#### **"Digital Signal Processing Laboratory Enhancement"**

This project builds on an already existing digital signal processing laboratory at this institution. The extensions to this lab include a software development system, analog interface boards, dynamic signal analyzers and personal computers. Using this equipment, students gain an understanding of the concepts of design trade-offs in digital filtering and spectral analysis.

This award is being matched by an equal sum from the grantee.

|                            |                        |
|----------------------------|------------------------|
| Deep Aggarwal              | USE 8853274            |
| Bayamon Technological Univ | \$12,300               |
| Bayamon, RQ                | Engineering-Mechanical |

#### **"Biomedical Instrumentation Laboratory"**

This project provides undergraduate students with a hands-on experience in Biomedical Instrumentation. The laboratory that supports the project includes equipment such as: force transducers, EKG machines, sphygmomanometers, magnetic and ultrasonic flow meters, and A/D and D/A converters.

Experiments in this laboratory familiarize students with the underlying physiological principles, the application of biomedical instruments, and the installation, calibration, inspection, preventative maintenance and repair of biomedical equipment.

This award is being matched by an equal sum from the grantee.

|                            |                        |
|----------------------------|------------------------|
| Hamed Javad                | USE 8852456            |
| Midlands Technical College | \$31,540               |
| Columbia, SC               | Engineering-Electrical |

#### **"Integrated Process Control Laboratory"**

This project allows students in a two-year technology program to study Process Control in a state-of-the-art training laboratory. This laboratory, equipped with programmable logic controllers, permits students to apply their understanding of Classical Control Theory within a totally



integrated technological setting. These students are being prepared to function in industrial environments that are increasingly moving toward automated manufacturing processes.

This award is being matched by an equal sum from the grantee.

|                              |                        |
|------------------------------|------------------------|
| Floyd L. Wilcox, Sr.         | USE 8853149            |
| Tri-County Technical College | \$98,759               |
| Pendleton, SC                | Engineering-Electrical |

#### **"Automated Student Laboratory for Electronic Engineering Technology Curriculum"**

This project enhances Electronics education at this community college. Students are able to use this institution's automated circuits laboratory stations to: calculate and set circuit parameters for their circuit designs, analyze circuit performance using the computer simulator, and test the hardware version of their design for its real behavior. The equipment that supports this lab, primarily from Hewlett Packard, includes: Measurement Automation Systems, display interfaces and resource managers, graphics printers, function generators, digital multimeters, dual channel digital oscilloscopes, power supplies and programmable scanners.

This award is being matched by an equal sum from the grantee.

|                        |                        |
|------------------------|------------------------|
| Wayne Jones            | USE 8853340            |
| Chattanooga State Tech | \$88,200               |
| Chattanooga, TN        | Engineering-Mechanical |

#### **"Computer Integrated Manufacturing"**

This project supports a hands-on experience for students in this institution's program in Computer Integrated Manufacturing (CIM). Using the equipment in the CIM lab, students learn how to apply existing state-of-the-art technology to a real life manufacturing environment. The project builds on an already existing automated manufacturing cell. Two computers and several work stations are linked to the cell. Students experiment with all processes in the manufacturing cycle—production forecasting through design, manufacturing and shipping. The unique aspect of this facility is that students interact with a common data base to coordinate all production processes using real machine tools.

This award is being matched by an greater than equal sum from the grantee.

|                            |                   |
|----------------------------|-------------------|
| Steven S. Crider           | USE 8853322       |
| Christian Brothers College | \$19,000          |
| Memphis, TN                | Engineering-Civil |

#### **"Civil Engineering Water Resources Laboratory"**

This project strengthens students' understanding of the fundamental principles of Water Resources Engineering through the use of a new laboratory. The laboratory concentrates on water quantity rather than quality, giving students a physical understanding of the conservation of mass, momentum and energy principles. The equipment supporting this project includes: hydraulics bench, pressure gage, orifices, open channel flume, pipe networks, soil permeability meter and accessories.

This award is being matched by an equal sum from the grantee.

|                     |                        |
|---------------------|------------------------|
| Parimal A. Patel    | USE 8853283            |
| University of Texas | \$95,832               |
| San Antonio, TX     | Engineering-Electrical |

#### **"Digital Systems Design Workstations"**

This project permits undergraduate students in this institution's Engineering program to study Digital Design in a state-of-the-art environment. The laboratory that supports this project consists of four digital design workstations. Using these workstations, students are exposed to a broad range of simulation capabilities, including standard component modeling, modeling using a high-level language and physical modeling employing actual Very Large Scale Integrated Circuits. Using such computer-assisted tools, students obtain practical exposure to complex digital design and analysis techniques.

This award is being matched by an equal sum from the grantee.

|                     |                        |
|---------------------|------------------------|
| John L. Schmalzel   | USE 8851970            |
| University of Texas | \$79,065               |
| San Antonio, TX     | Engineering-Electrical |

#### **"Integrated PC-Instrument Workstation Laboratory"**

The Senior-level Electrical Engineering Laboratory facilities at this institution have been upgraded to better prepare the students for productive roles in industry. This project provided laboratory workstations that allow students to integrate analysis and design software tools with measurement instrumentation. The integrated workstations allow the faculty to not only cover traditional electronic circuit problems in much greater depth, but also allow coverage of a much broader range of topics. The

major components of the workstation consist of the Hewlett-Packard PC Instrumentation System, an 80283-based AT configured with a floating-point co-processor and a 71Mbyte hard disk, and the ASYST signal analysis software. With the workstations, students are able to efficiently move between analysis and measurement which facilitates the iterative approach to circuit design. An additional benefit is student familiarity with automated measurement systems similar to that found in the automatic test environment in industry.

This award is being matched by an equal sum from the grantee.

|                    |                   |
|--------------------|-------------------|
| Alan J. Phillip    | USE 8851451       |
| Norwich University | \$17,867          |
| Northfield, VT     | Engineering-Other |

#### **"Environmental Monitoring Capability for Volatile Organic Compounds"**

This project provides the Environmental Engineering Technology undergraduate curriculum at this institution with the laboratory capability to sample and analyze low concentrations of volatile organic compounds in air, water and soil. The state-of-the-art pollutant monitoring equipment which students use include: a flame ionization detector gas chromatograph, a thermal desorber unit, a photoionization detector, a volatile and semivolatile organic sampling train and personal and ambient air sampling devices. This equipment broadly enhances the spectrum of instruments students can use in their Air Pollution, Water Chemistry and Hazardous Waste laboratory courses and allows them hands-on experiences in the methods and equipment they are most likely to use early in their professional careers.

This award is being matched by an equal sum from the grantee.

|                               |                        |
|-------------------------------|------------------------|
| Norman H. Wolford             | USE 8851476            |
| Central Washington University | \$49,889               |
| Ellensburg, WA                | Engineering-Electrical |

#### **"An Integrated Approach to Microprocessor and Microcomputer Education"**

This project provides two state-of-the-art microcomputer systems to replace obsolete PDP-11 minicomputers and associated first generation microprocessor trainers. These systems are networked to a basic and an advanced microprocessor training laboratory. Each laboratory incorporates 12 workstations; consisting of a terminal, an Educational Computer Board and a solderless breadboard for experiments. The basic laboratory uses an 8-bit microprocessor

and is used to instruct Electronic Engineering Technology majors and non-majors; including future technology education teachers. The advanced laboratory is used to provide instruction in microprocessor systems to the four-year graduates of the Electronic Engineering Technology and the Industrial Electronics Programs. This laboratory upgrade significantly improves the quality of education offered by the Department of Industrial and Engineering Technology by providing common equipment throughout the laboratory program and increased laboratory productivity through better hardware and software reliability.

This award is being matched by an equal sum from the grantee.

|                    |                   |
|--------------------|-------------------|
| Rolf T. Skrinde    | USE 8852097       |
| Seattle University | \$13,410          |
| Seattle, WA        | Engineering-Civil |

#### **"Enhancing Laboratory Experiences in Wastewater and Hazardous Waste Treatment"**

This project enhances the existing program in Wastewater and Hazardous Waste Treatment. With the ion chromatograph obtained with this award, students are able to study industrial and hazardous waste treatment in a hands-on laboratory at the same time they are studying the concepts in the classroom.

This award is being matched by an equal sum from the grantee.

|                          |                        |
|--------------------------|------------------------|
| Swaminathan Balachandran | USE 8851559            |
| University of Wisconsin  | \$62,000               |
| Platteville, WI          | Engineering-Mechanical |

#### **"Enhanced Computer Integrated Manufacturing Laboratory"**

The quality of undergraduate Engineering education at this institution is improved through the acquisition of state-of-the-art Computer Integrated Manufacturing (CIM) equipment. An already existing CIM laboratory is enhanced through the addition of a pneumatic robot, an automated storage and retrieval system, loop conveyor, programmable conveyor, CNC mill, servo robot controller, vision system, bar code reader, computer interfaces and associated software.

This enhanced laboratory permits the teaching of CNC machine programming, application of vision in manufacturing, principles of programmable logic controllers, integration of materials handling in manufacturing, local area networking, and human aspects of automated manufacturing.

This award is being matched by an equal sum from the grantee.

|                         |                   |
|-------------------------|-------------------|
| Thomas E. Holland, Jr.  | USE 8851558       |
| University of Wisconsin | \$18,405          |
| Platteville, WI         | Engineering-Other |

### **"Statistical Process Control Laboratory"**

The equipment dedicated to this project supports the integration of Statistical Process Control (SPC) into the undergraduate Industrial Engineering Manufacturing Laboratory at this institution. Students perform hands-on experiments in SPC techniques in a real-time data collection environment to gain expertise in both manufacturing and the automation of SPC.

The equipment that supports this project includes: digital measuring instruments to measure dimensions of parts as quality characteristics; data collection and transmission devices to collect or transmit data from gages to microcomputers; microcomputers to process real-time data; peripheral devices to produce control charts and reports; and, SPC software that analyzes quality information in real time.

This award is being matched by an equal sum from the grantee.

**Lang W. Lee** USE 8851683  
**Tamer Ceylan** \$14,440  
 University of Wisconsin Engineering-Mechanical  
 Platteville, WI

### **"Instrumentation for a Wind Tunnel"**

This project improves on this institution's already existing wind tunnel laboratory setup. Undergraduate students

using this enhanced lab gain experience with leading-edge aerodynamic measurement techniques. The enhanced wind tunnel laboratory includes a sting balance, a two-dimensional traversing mechanism, a Scanivalve pressure scanner and synchro transmitter-slipring unit. This equipment is interfaced to computers permitting students to study external flow phenomena associated with stationary or rotating objects.

This award is being matched by an equal sum from the grantee.

|                         |                        |
|-------------------------|------------------------|
| Piyare L. Sharma        | USE 8851439            |
| University of Wisconsin | \$26,000               |
| Platteville, WI         | Engineering-Electrical |

### **"Equipment Acquisition for Digital Control Laboratory"**

This project enhances the digital controls offerings at this institution. Using the laboratory funded by this award, undergraduate electrical engineering students study theoretical and practical principals of automatic controls, discrete time control systems and digital signal processing. The equipment supporting this lab includes: TMS32010 Evaluation Modules with analog interface boards, macro assembler/linker, simulators, Hitachi V-1100A oscilloscopes, IBM PS/2 PC's and Epsom printers.

This award is being matched by an equal sum from the grantee.

## INTERDISCIPLINARY AND MULTIDISCIPLINARY SCIENCES

David P. Campbell  
California State Polytechnic Univ  
Pomona, CA

### **"Extended SEM Capabilities for Undergraduate Science Instruction Through Microcomputer Interfacing"**

This project provides students in Electron Microscopy and Computer Science exposure to the use of microcomputers and array processors as a modern means of data collection and manipulation in the context of image processing. The use of a microcomputer interfaced to the scanning electron microscope (SEM) extends the instructional capabilities of the instrument and exposes the students to computers in new scientific applications. Microcomputers interfaced to a computer with an array processor allow the

use of fast fourier transform (FFT) processing of images obtained from the SEM. Student instruction is enhanced by the extended capabilities of the instrument: increased resolution, improved signal-to-noise ratio, and operation at low beam currents.

The grantee provides funds for this project that are an equal match for the NSF award.

Jay H. Jones  
University of La Verne  
La Verne, CA

### **"Enhanced Instrumentation for Undergraduate Instruction in Environmental Chemistry"**

The addition of two items for the central instrument facility: 1) a purge and trap system, and 2) a high perfor-



mance liquid chromatograph, provides full support for the current instruction in the environmental sciences and substantial support for an environmental engineering program. The additional instruments augment those already available and provide all the major instrumentation needed for up-to-date instruction in the Environmental Chemistry component of the environmental programs. The augmented instrumentation supports specified EPA methodology and the development of novel methods for environmental analysis.

The grantee provides funds for this project that are an equal match for the NSF award.

M. Ali Montazer  
University of New Haven  
West Haven, CT

USE 8852376  
\$21,746  
Inter/Multi-  
disciplinary

#### **"Human Factors/Ergonomics Laboratory Enhancement"**

This project permits undergraduate students to study human factors/ergonomics in a state-of-the-art laboratory. Students focus on gathering information on human capabilities and capacities for use in optimal design of jobs, products, equipment and the workplace.

The equipment included in this laboratory includes: gas analyzing equipment used to determine physiological cost of heavy physical work; an environmental chamber which is used to simulate different environmental conditions—for the study of the effect of factors such as heat on work performance; anthropometric instruments used to measure body dimensions in relation to the design and evaluation of the workplace and equipment; and, a microcomputer that is interfaced to the laboratory for data acquisition and analysis.

The equipment is used by students to conduct laboratory experiments as part of their coursework and independent studies and project.

This award is being matched by an equal sum from the grantee.

Robert H. Peterson  
St Leo College  
Saint Leo, FL

USE 8851263  
\$5,300  
Inter/Multi-  
disciplinary

#### **"Improved Laboratory Instruction in Biology and Chemistry with Modern Ultraviolet-Visible Spectroscopy"**

A modern ultraviolet-visible recording spectrophotometer and an electronic analytical balance are used to im-

prove courses in Cell Physiology and Organic Chemistry. In Cell Physiology, experiments in protein characterization, enzyme kinetics, DNA quantitation, chromatographic purification, and assay of egg white lysozyme are upgraded. In the Organic Chemistry laboratory, ultraviolet-visible spectroscopy enhances student understanding of the relationship of structure to spectra, the determination of the distribution of coefficients of ketones, and the study of the spectral consequences of hydrogen bonding.

The grantee provides funds for this project that are an equal match for the NSF award.

Marshall P. Cady, Jr.  
Indiana University Southeast  
New Albany, IN

USE 8851189  
\$21,210  
Inter/Multi-  
disciplinary

#### **"A Computer Data Acquisition and Control Laboratory for Undergraduate Courses"**

The data acquisition and control laboratory serves the needs of several courses. The laboratory includes analog and digital electronics, computers, computer interfacing devices and software. Topics taught in the laboratory include: a) hardware and software interfacing techniques, b) methods of computer based automation, measurement, data acquisition, experiment control, and data analysis.

The grantee provides funds for this project that are an equal match for the NSF award.

Nancy P. Hamilton  
University of Northern Iowa  
Cedar Falls, IA

USE 8853326  
\$12,174  
Inter/Multi-  
disciplinary

#### **"Motion Analysis in Undergraduate Kinesiology"**

The mechanics of human motion is taught through the use of a video/computer motion analysis system. This system is incorporated in laboratory experimentation in courses in undergraduate Kinesiology. The motion analysis system is applied directly to the teaching of Kinematics and indirectly to the teaching of Kinetics. The equipment consists of a 2D video analysis unit, a computer subsystem and a video subsystem.

The grantee provides funds for this project that are an equal match for the NSF award.

Richard P. Zerger  
McPherson College  
McPherson, KS

USE 8851437  
\$13,950  
Inter/Multi-  
disciplinary

#### **"Bio-Analytical Instrumentation for Undergraduates in the Chemical and Biological Sciences"**

This project provides improved laboratory instrumentation to prepare undergraduate students majoring in the

chemical and biological sciences for careers in areas associated with biotechnology. This project is part of a larger plan to restructure the curriculum and associated facilities to meet the changes required in chemical and biological education. The High Performance Liquid Chromatography (HPLC) system will complement an existing core of analytical instruments and methods available to students in the laboratory portion of the courses, Biochemistry and Instrumental Analysis, taken by Chemistry and Biology majors, and in the Interdisciplinary Undergraduate Research Program in which all chemical and biological science majors are required to participate. The availability of HPLC will permit laboratory instruction in HPLC techniques and will greatly expand the research topics available to students in the area of biochemistry.

The grantee is matching the award from non-Federal sources.

Jefferson T. Turner  
Robert H. Caverly  
Southeastern Massachusetts  
University  
North Dartmouth, MA

USE 8851158  
\$66,422  
Inter/Multi-  
disciplinary

#### **"Scanning Electron Microscopy for Undergraduate Science and Engineering Education"**

Students in Biology, Electrical Engineering and other fields of study learn to use the Scanning Electron Microscope (SEM) for measurements related to their major area of study. A formal course that teaches students the principles of operation and the capabilities of the SEM as well as the procedures for using the instrument is offered on a regular basis. The particular instrument has several features that allow measurements not possible with instruments not possessing these features. After completing the course, the students have access to the SEM for individual project work.

The grantee provides funds for this project that are an equal match for the NSF award.

Daniel E. Wujek  
Central Michigan University  
Mount Pleasant, MI

USE 8851238  
\$66,321  
Inter/Multi-  
disciplinary

#### **"Expanded Scanning Electron Microscopy Instruction for Undergraduates"**

Students in an ongoing course are introduced to the full range of capabilities of a modern scanning electron microscope and students in the Mineralogy and Petrology courses learn of these capabilities through several laboratory exercises. In a new course, students receive hands-on experience

with state-of-the-art equipment through extensive laboratory work. Their level of background in areas of transmission electron microscopy and scanning electron microscopy enable the students to present more favorable credentials to prospective employers. Further, students have the technical capabilities that allow them to pursue goals in either graduate school or medical school research.

The grantee provides funds for this project that more than match the NSF award.

S. Valentine  
Dull Knife Memorial College  
Lame Deer, MT

USE 8853146  
\$45,974  
Inter/Multi-  
disciplinary

#### **"Technical Graphics Laboratory"**

This project permits this institution to offer a degree program in technical graphics, one that includes graphical representation for industry as well as CAD/CAM applications. The equipment that supports the project includes twelve (12) Macintosh II microcomputers and associated hardware and software to permit students to learn graphical concepts in a project-oriented studio environment.

This award is being matched by an equal sum from the grantee.

Thomas S. Lillie  
Lafayette College  
Easton, PA

USE 8851625  
\$86,150  
Inter/Multi-  
disciplinary

#### **"Incorporation of Fourier Transform Nuclear Magnetic Resonance (FT NMR) Spectroscopy into the Undergraduate Physical Science Curriculum"**

This project introduces contemporary Nuclear Magnetic Resonance (NMR) Spectroscopy into the Physical Science curriculum by acquisition and use of a high-field FT NMR spectrometer. Major advances over the past decade have transformed this technique into a fundamental tool of chemistry and physics, as well as a cornerstone of emergent medical technology (NMR imaging). Available equipment is both accessible to nonexperts and capable of performing such previously difficult or impossible tasks as high-field NMR, 2-D NMR, and relaxation measurements. With this equipment the students—a substantial number go on to careers in science, medicine and industry—have hands-on experience with equipment and techniques they will encounter later. The use of FT NMR spectroscopy is integrated into the core Chemistry and Physics curriculum, which is also critical to majors in related fields. Improved classes and laboratories, together with existing faculty expertise, serve to enhance student research.

The grantee provides funds for this project that are an equal match for the NSF award.

Daniel Pindzola  
Wilkes College  
Wilkes-Barre, PA

USE 8852892  
\$56,700  
Inter/Multi-  
disciplinary

#### **"Undergraduate Instruction for Testing Organics in the Environment"**

A gas chromatograph-mass spectrometer system with thermal desorption capability has been acquired which permits the quantitative identification of complex organic compounds at low levels in air, water, and soil. This system complements the inorganic, microbiologic, and radiologic environmental monitoring and analysis capabilities of the department. Such equipment is vital to the education of the students in the earth sciences and the environmental sciences and engineering areas, all of whom receive extensive training in most aspects of environmental testing and most of whom secure positions with governmental agencies, private laboratories, environmental groups, or companies directly concerned with environmental testing and assessment. The relative importance of organic compounds in the environment is increasing and students should be provided with the education necessary to identify and assess the significance of these compounds.

The grantee provides funds for this project that are more than an equal match for the NSF award.

Frederick M. Wiseman  
Johnson State College  
Johnson, VT

USE 8853297  
\$58,393  
Inter/Multi-  
disciplinary

#### **"A Computing Center for Undergraduate Science and Mathematics"**

A computing facility has been established to support curricula in Mathematics and the sciences. The computing center's mission is the education of students in computer aided data analysis and presentation such as that they will encounter in the workplace and in graduate education. The close coupling of the graphics-based computing facility and a series of courses integrates in a unique way the viewpoint and intellectual ecumenism characteristic of small colleges with the data analysis and presentation rigor found in specialized programs.

The grantee provides funds for this project that are an equal match for the NSF award.

Jeffrey H. Byers  
Middlebury College  
Middlebury, VT

USE 8852661  
\$81,000  
Inter/Multi-  
disciplinary

#### **"Nuclear Magnetic Resonance Instruction for Undergraduates"**

The Nuclear Magnetic Resonance spectrometer system is used to introduce undergraduate Chemistry and Physics students to an important area of modern spectroscopy. The instrument is used in Introductory Organic Chemistry, Advanced Organic Chemistry, and Quantum Physics courses. This instrument is also used in a newly developed integrated laboratory course in Inorganic, Analytical, and Physical Chemistry. Students in the senior thesis programs in Chemistry and Physics utilize this instrument extensively, and thus gain instrumental experience with modern equipment similar to that they will encounter in industry or graduate school. This hands-on experience also enhances understanding of the theoretical concepts introduced in the lecture portion of the courses.

The grantee provides funds for this project that are an equal match for the NSF award.

Hugh D. Sullivan  
R. William Clark  
Eastern Washington University  
Cheney, WA

USE 8851382  
\$66,348  
Inter/Multi-  
disciplinary

#### **"Advanced Workstation Applications and Graphics Laboratory"**

The Advanced Workstation Applications and Graphics Laboratory includes a number of scientific workstations in a network with peripherals such as printers, plotters, a video recorder and associated software. The system is expandable and could include as many as 40 workstations. The laboratory network is connected to a campus network to extend access. The laboratory is expected to: 1) improve instruction in the sciences through detailed visual displays of molecular structures, simulations of complex systems, complex mathematical surfaces and functional relationships; 2) provide students with the tools for computer graphics and other applications requiring complex, high-speed computations such as CAD, map preparation from large data bases, and modeling of electronic and molecular structures; 3) provide students with state-of-the-art instruction in computer graphics; 4) prepare high-quality, sophisticated courseware which requires high-resolution graphics.

The grantee provides funds for this project that are an equal match for the NSF award.



David C. Brubaker  
Seattle University  
Seattle, WA

USE 8852851  
\$84,617  
Inter/Multi-  
disciplinary

**"An Interdisciplinary Approach to Data Management in Undergraduate Instruction"**

This project seeks to provide an interdisciplinary approach for undergraduate study of modern data management techniques and an interdisciplinary team approach to environmental problem solving. This program builds on the Biology Department's experience with microcomputer-based laboratory work stations and the Civil Engineering Department's Design Center concept. The work stations interface digital laboratory equipment, hand-held data loggers and weather telemetry instruments with data acquisition hardware providing rapid data acquisition, computer analysis and evaluation. The program focuses on collaborative work in sanitary and toxic waste management, which requires training in modern data management techniques and interdisciplinary approaches to problem solving. Students learn data management and instrumentation techniques through course work, laboratory exercises and an interdisciplinary design project. Students benefit through learning and practicing modern data management techniques appropriate to their disciplines and have the experience of working together as a team to find solutions to environmental problems. This interdisciplinary approach models real life situations, increases student confidence in problem solving ability, and opens new career opportunities for students in both departments.

The grantee provides funds for this project that are an equal match for the NSF award.

Ann M. Penzkover  
Lac Courte Oreilles  
Ojibwa Community College  
Hayward, WI

USE 8851410  
\$5,125  
Inter/Multi-  
disciplinary

**"Project CABLE (Chemistry and Biology Laboratory Education)"**

This college is located on the Lac Courtes Oreilles Reservation of rural Northern Wisconsin. The College population is 95% Native American, of which 70% are women. Due to the isolation of the Northern Wisconsin woodlands and the limited resources of the students, the College has become the focal point of educational services within the area.

Previously, science courses were taught with a minimum of laboratory work. Instructors prepared demonstrations for students to view in the local high school laboratory which is not equipped for scientific investigation beyond the secondary curriculum. The new laboratory equipment is providing the means to begin to explore Biology and Chemistry beyond the post-secondary level. Furthermore, Native American students are being given the opportunity to research scientific concepts at the experimental level which is consistent with Native American learning styles.

The grantee is matching the award from non-Federal sources.

## MATHEMATICS

P. K. Subramanian  
California State Univ  
Los Angeles, CA

USE 8852276  
\$50,449  
Mathematics

**"Microcomputer Laboratory Facility to Upgrade the Teaching of Undergraduate Numerical Analysis and Related Courses"**

The Department of Mathematics and Computer Science is establishing a microcomputer laboratory for advanced undergraduate courses at this institution where two thirds of the student body are minorities. The computational nature of the Numerical Analysis, Numerical Calculus, and Linear Programming courses is being revised and Applied Linear Algebra are being added to the curriculum.

The laboratory consists of 30 computers (with access to all campus computers), video projector and printing stations.

The grantee is providing an equal sum obtained from non-Federal sources.

Leslie V. Foster  
Jane M. Day  
San Jose State University  
San Jose, CA

USE 8852808  
\$48,182  
Mathematics

**"Computing Equipment for Realistic Modelling"**

Four very fast numerical coprocessors enable the incorporation of realistic models into undergraduate applied mathematics curriculum; solution of numerically complex problems posed by industry; and enhancement of the new bachelors degree program in Applied and Computational Mathematics.

The equipment provides high speed computing and state-of-the-art graphics in a networked environment for upper

division applied mathematics courses and industrial projects. Numerical Analysis, Linear and Non-linear Programming, and Partial Differential Equations introduce realistic modeling which minimizes the programming required so that the mathematics concepts, techniques and graphical output can be emphasized.

Faculty workshops in the curriculum and equipment use are also offered.

The grantee is providing an equal sum obtained from non-Federal sources.

|                         |             |
|-------------------------|-------------|
| Jean B. Chan            | USE 8852470 |
| Sonoma State University | \$8,270     |
| Rohnert Park, CA        | Mathematics |

#### **"Development of a Modern Undergraduate Mathematics Laboratory"**

The Department of Mathematics is initiating a first phase of a mathematics laboratory for several courses. In remedial mathematics, students work problems in algebra and geometry, while in calculus, students conduct experiments. In addition, the Mathematical Models and Numerical Analysis curriculum is being updated and classes are held in the mathematics laboratory.

The grantee is providing an equal sum obtained from non-Federal sources.

|                             |             |
|-----------------------------|-------------|
| Stanley D. Nel              | USE 8852453 |
| University of San Francisco | \$42,897    |
| San Francisco, CA           | Mathematics |

#### **"An Applied Mathematics Computing Laboratory"**

Using the tools of practicing applied mathematicians—symbolic mathematics, numerical analysis and graphics packages—the faculty is restructuring the teaching of Calculus, Linear Algebra, and Differential Equations. The project applies the successful philosophy and strategies of the department's Applied Mathematics Laboratory to undergraduate mathematics courses. The laboratory sessions focus on applications and not programming. Students work on a team solving applied mathematics problems posed by local industry. Replicability will be accomplished through publication of the software packages and problems.

The grantee is providing an equal sum for the equipment obtained from non-Federal sources.

|                     |             |
|---------------------|-------------|
| Denny Burzynski     | USE 8852707 |
| West Valley College | \$49,724    |
| Saratoga, CA        | Mathematics |

#### **"Innovative Curriculum Applications in the Community College Mathematics Classroom"**

This project moves the College's successful prior efforts in the computerization of the curriculum into a more ad-

vanced stage. The mathematics faculty members have been forward looking in their extensive use of the previously available computing devices in their instructional program. They are now undertaking an expansion that incorporates important new technologies, i.e., computer graphics and symbolic algebra systems.

The grantee is providing an equal sum obtained from non-Federal sources.

|                  |             |
|------------------|-------------|
| Raymond Smith    | USE 8851727 |
| Whittier College | \$13,813    |
| Whittier, CA     | Mathematics |

#### **"Computer Based Instruction in Mathematics"**

Computer applications are being added to the Calculus and Mathematics for the Liberal Arts courses.

Calculus students are using the graphing, symbol manipulation, numerical calculation capabilities of Macintosh computers to better understand the concepts of Calculus. The redesigning of the Mathematics for Liberal Arts course centers on the use of mathematics and computers in real world situations.

The grantee is providing an equal sum for the equipment obtained from non-Federal sources.

|                  |             |
|------------------|-------------|
| J. Douglas Child | USE 8852244 |
| Rollins College  | \$46,528    |
| Winter Park, FL  | Mathematics |

#### **"The Design of a Computer Algebra System to Effect a More Relevant Mathematics Curriculum"**

This project modifies computer algebra systems (CAS) to make it a more suitable, usable learning tool for calculus and then pre-calculus students. The Principal Investigator is the first person to develop a prototypical intelligent tutoring system and a Macintosh graphic interface to Maple.

The new computer technology funded by this award and curricular revisions are the basis for faculty retraining and teaching of experimental applied calculus, pre-calculus, and summer workshops for secondary school teachers at Rollins College. The equipment is used for a computer laboratory components, and faculty desktop access to CAS.

Two of the senior staff have received grants from the Sloan Foundation to develop CAS. The grantee is providing an equal sum for the equipment obtained from non-Federal sources.

|                    |             |
|--------------------|-------------|
| Gareth Williams    | USE 8851567 |
| Stetson University | \$30,390    |
| Deland, FL         | Mathematics |

#### **"The Completion of a Microcomputer Network"**

This project establishes a campus microcomputer network for students and teachers to access computing re-

sources and software at Stetson University. The network is linked with national networks. A modern teaching environment adapting the latest software for students and teachers explores ways of learning and applying mathematics. The curriculum of calculus, linear algebra, differential equations, and chaotic dynamical systems are enhanced by this network. There will be an internal and external evaluation of the effectiveness of the network and curriculum impact.

The grantee is providing an equal sum for the equipment obtained from non-Federal sources.

|                                    |             |
|------------------------------------|-------------|
| Robert J. Lopez                    | USE 8851339 |
| Rose-Hulman Institute of Tech FY88 | \$100,000   |
| Terre Haute, IN                    | Mathematics |

**"A Symbolic, Numerical and Graphical Computations Lab to Support a Revised Curriculum in Calculus and Differential Equations"**

The Department of Mathematics at this engineering institution is building, for all freshman and sophomores, a laboratory for symbolic, numerical and graphical computations.

SUN workstations and the computer algebra system MACSYMA are the basis for radical change in the mode and methodology of the calculus and differential calculus sequences. The emphasis is to impact the engineering curriculum by stressing "mathematical experimentation" by use of powerful research tools used in industry.

The grantee is providing an equal sum obtained from non-Federal sources.

|                       |             |
|-----------------------|-------------|
| Joel P. Lehmann       | USE 8852197 |
| Valparaiso University | \$20,696    |
| Valparaiso, IN        | Mathematics |

**"Integration of Mathematical Software into Calculus Courses"**

This award establishes a microcomputer laboratory to support the calculus sequence. Numerical, symbolic and graphing capabilities of computers are used to change the instructional emphasis in Calculus to an expanded coverage of concepts.

This award is being matched by an equal sum from the grantee.

|                             |             |
|-----------------------------|-------------|
| Lillie F. Crowley           | USE 8851488 |
| University of Kentucky      | \$28,983    |
| Lexington Community College | Mathematics |
| Lexington, KY               |             |

**"Microcomputer Laboratory for Calculus Instruction"**

A computer laboratory in the Department of Mathematics facilitates the restructuring of the Calculus sequence.

Computer assignments and writing of reports are a main focus of the teaching strategy.

The grantee is matching the NSF award with an equal sum obtained from non-Federal sources.

|                           |             |
|---------------------------|-------------|
| Christine E. McLaren      | USE 8851944 |
| Moorhead State University | \$29,157    |
| Moorhead, MN              | Mathematics |

**"Instructional Computer Laboratory for Introduction to Statistics"**

This project establishes an IBM micro-computer laboratory for two elementary statistics courses requiring a background in algebra and courses for pre-college teachers.

With the use of the statistical package MINITAB, eleven hundred students per year carry on real world exploratory statistical analysis, look for patterns and relationships, confirm or disprove the expected, and discover new phenomena. Problems using real data from accounting, agriculture, economics, management, marketing and medicine are used.

The primary impact on the secondary mathematics majors and elementary education majors is the development of computer skills necessary for classroom teaching, concepts of probability and descriptive statistics.

The principal investigator is a biostatistician with publications in computer assisted analysis.

The grantee is providing an equal sum obtained from non-Federal sources.

|                 |             |
|-----------------|-------------|
| Alan Magnuson   | USE 8851796 |
| St Olaf College | \$14,680    |
| Northfield, MN  | Mathematics |

**"Integration of Computer Tools into Classroom Mathematics Instruction"**

The Department of Mathematics is integrating symbolic, numerical, and graphical computing tools into all courses in its Mathematics curriculum via an electronic blackboard. Department faculty are developing course materials, software, and documentation.

Four classrooms are equipped with a microcomputer and large screen projector. With well developed software tools and the means for using them in a classroom, the lecturers communicate a more accurate picture of the nature of Mathematics and its ideas.

The Department has been in the forefront in the development of materials for and in the use of symbolic manipulators in Calculus curriculum.

The grantee is providing in equal sum obtained from non-Federal sources.



Patricia R. Wilkinson  
CUNY Borough of Manhattan  
Community College  
New York, NY

USE 8851194  
\$37,421  
Mathematics

Betty Lou Acord  
Connors State College  
Warner, OK

USE 8852310  
\$13,609  
Mathematics

#### **"Project MICRO-CALC: Microcomputer for Classroom and Learning Center Calculus"**

This institution, the only public two-year college in Manhattan, is creating a microcomputer classroom for its precalculus and Calculus courses. They are also adding computers to their Learning Center for the use of the precalculus and Calculus students.

The precalculus and Calculus curriculum are being enhanced with interactive graphic activities which emphasize basic concepts, functions and their properties.

Half of the students are majors in the newly established Science Concentration, Engineering Technology and Computer Science. The student population is 67% female and 83% minority.

The grantee is providing an equal sum for the equipment obtained from non-Federal sources.

William C. Bauldry  
Appalachian State University  
Boone, NC

USE 8853085  
\$45,680  
Mathematics

#### **"Mathematical Sciences Microcomputer Teaching Laboratory"**

The Mathematical Sciences Department is constructing a mathematical sciences microcomputer teaching laboratory for their calculus and discrete mathematics sequences.

An electronic classroom of interconnected student workstations, printers and instructor demonstration unit provide instant computer access during lectures. The laboratory is used by students to conduct experiments and complete out-of-class assignments.

Members of the faculty have developed a new curricula, software and are writing a Calculus Laboratory Manual.

The grantee is providing a slightly greater sum obtained from non-Federal sources.

#### **"Upgrading Mathematical Skills Through Computer Assisted Instruction"**

The project establishes a computer laboratory for assisting with the instruction of remedial students. Individualized student plans are designed and monitored through testing and interviews. The project presents a significant contribution to the institution's interest in improving the mathematical background and interest in a client group that includes minorities and females.

This award is being matched by an equal sum from the grantee.

Stillman E. Sims  
St Mary's University  
San Antonio, TX

USE 8852311  
\$45,448  
Mathematics

#### **"A Microcomputer Lab for a New Degree Program in Mathematical Science"**

A microcomputer laboratory of varying capacity IBM computers in the Department of Mathematics at St. Mary's University, San Antonio facilitates the development of a new Bachelor of Science program in Applied and Computational Mathematics. A new course in mathematical modelling is being introduced and computers are integrated into several mathematics courses starting with the Calculus sequence.

The award is matching by an equal amount from the grantee.

Dwight Goode  
Texas A & I University  
Kingsville, TX

USE 8852083  
\$19,213  
Mathematics

#### **"Calculus Enhancement Project"**

With the recognition that current industrial uses of mathematics includes numerical, graphical and symbolic systems, the faculty enhances their Calculus instruction with an open lab that is available for demonstrations and student homework assignments.

The award is being matched by an equal amount from the grantee.

## PHYSICS

|                            |             |
|----------------------------|-------------|
| Charles W. Leming          | USE 8851244 |
| Henderson State University | \$7,500     |
| Arkadelphia, AR            | Physics     |

### **"Computational Methods in the Undergraduate Physics Curriculum: An Integrated Approach"**

This project supported the purchase of four microcomputer-based color graphics workstations, a laser printer, and associated software. This equipment is used to improve instruction by integrating computational methods and computer graphics into the undergraduate curriculum in physics. These techniques and capabilities are applied to problems in classical mechanics, modern physics, and quantum mechanics.

The grantee will match the NSF award with an equal amount of funds.

|                             |             |
|-----------------------------|-------------|
| Michael S. Belsley          | USE 8851582 |
| California State University | \$25,887    |
| Long Beach, CA              | Physics     |

### **"Creating an Undergraduate Modern Optics Laboratory in Lasers and Laser Spectroscopy"**

The Physics Department is creating a student laboratory to introduce undergraduates to fundamental concepts and current research techniques in the field of modern optics. In the first half of the course, students build up a basic working knowledge of the principles of lasers by constructing both a pulsed dye laser and a continuous wave helium-neon laser cavity. In the second half of the course, students are given the opportunity to carry out detailed experiments, concentrating on a specific area in modern optics. Initially three topics, acousto-optic modulation, molecular spectroscopy, and holography/optical information processing are offered. Subsequently, additional topics such as fiber optics and nonlinear crystal optics are developed.

This award is being matched by an equal sum from the grantee.

|                     |             |
|---------------------|-------------|
| James C. Eckert     | USE 8852804 |
| Harvey Mudd College | \$17,228    |
| Claremont, CA       | Physics     |

### **"Undergraduate Laboratory on the Measurement of Temperature Dependent Properties of Materials"**

One of the best methods for studying the underlying mechanisms associated with the properties of a material is

to make measurements of the temperature dependence of intrinsic properties of the material. This fact has been brought home forcefully in reviewing the work currently in progress on the new high transition temperature superconductors. Despite the importance of understanding the significance of such measurements and the techniques involved in making them, many students have had very little opportunity for laboratory exposure in this area. In this project two systems for the measurement of temperature dependent properties are being developed for use in the upper and lower level student laboratories. The systems include two Hansen High-Tran Liquid Transfer Systems, for sample cooling and temperature control, and two Hewlett Packard 150 series personal computer systems for data acquisition and real-time analysis. The new equipment is being used in the sophomore-level modern physics laboratory to make measurements of transport properties that can be explained in terms of a simple free-electron model, in the senior-level advanced laboratory to investigate the properties of superconductors, quasi-low dimensional conductors and other novel materials, and also in individual student research projects.

This award is being matched by an equal sum from the grantee.

|                   |             |
|-------------------|-------------|
| Clinton D. Harper | USE 8852053 |
| Moorpark College  | \$19,024    |
| Moorpark, CA      | Physics     |

### **"Development of a Modern Physics Laboratory for Lower-Division Undergraduate Students"**

This project begins the first phase of the development of a modern physics laboratory facility for freshman and sophomore science majors. Students principally affected are majors in physics, engineering, mathematics, electro-optics and the biological sciences.

The equipment supported by this award consists of six student gamma ray multi-channel analyzer stations. Each station, which typically will accommodate two students, has an IBM compatible Intel 80286 based microcomputer and plotter interfaced with a multi-channel analyzer board. A scintillation detector and amplifier detects gamma radiation from a number of sources, enabling the students to perform experiments in which isotopes are identified, absorption coefficients are measured and half-lives determined. The microcomputers purchased under this proposal are also used to interface with other experiments in the laboratory and to run related software packages.

The grantee is matching the NSF award with an equal amount of funds.

|                      |             |
|----------------------|-------------|
| Jack W. Beal         | USE 8851344 |
| Fairfield University | \$25,155    |
| Fairfield, CT        | Physics     |

**"Gamma Ray Spectroscopy Equipment for Undergraduate Laboratories and Projects"**

Fairfield University is purchasing a high-volume, high-resolution gamma-ray spectroscopy system including a lithium drifted germanium detector, a 16,384 channel analyzer, associated electronics, shielding, and data analysis equipment. This equipment permits improved instruction in an advanced nuclear science laboratory, and for individual projects to be carried out by advanced undergraduate students. Many of the projects involve the analysis of environmental samples using neutron activation analysis.

The grantee is providing funds greater than the NSF award, and a Microvax II computer for use with the system.

|                         |             |
|-------------------------|-------------|
| James S. Browder        | USE 8853090 |
| Jacksonville University | \$17,747    |
| Jacksonville, FL        | Physics     |

**"Electro-Optics Laboratory in Undergraduate Physics"**

The grantee is purchasing a spectrum analyzer system, an optical spectrometer, a photopolarimeter, a fiber optics system, components for a Michelson interferometer, and a portable personal computer. This equipment improves instruction through the implementation of a new laboratory course in electro-optics for upper-division physics majors. A unique feature of this program is the construction of some of the equipment for the course by advanced students as special projects.

The grantee is matching the NSF award with an equal amount of funds.

|                    |             |
|--------------------|-------------|
| Thomas A. Lick     | USE 8851575 |
| Stetson University | \$13,730    |
| Deland, FL         | Physics     |

**"Computer Based Data Acquisition and Plotting for Introductory Laboratory Experiments"**

The grantee is purchasing personal computers, digital plotters, and data acquisition modules. This equipment improves instruction in Introductory Physics laboratory courses. Students learn basic techniques of computer-controlled data

acquisition and analysis, and study basic physical phenomena that are too fast for measurement by traditional techniques.

The grantee matching the NSF award with an equal amount of funds.

|                        |             |
|------------------------|-------------|
| Richard J. Reimann     | USE 8851891 |
| Boise State University | \$12,105    |
| Boise, ID              | Physics     |

**"High Resolution Gamma Spectroscopy and Spectrum Analyzer for Undergraduate Laboratories, Projects and Undergraduate Student Research"**

The equipment supported by this award consists of a high-resolution gamma-ray spectroscopy system, and a fast Fourier transform spectrum analyzer. This equipment is used to provide research opportunities for undergraduate Physics majors, and to improve instruction in a senior Physics laboratory course and a senior Computer Science course. Student projects include the identification of radioactive isotopes in environmental samples, and investigations of magnet flux properties in high-temperature superconductors.

The grantee is matching the NSF award with an equal amount of funds from non-Federal sources.

|                            |             |
|----------------------------|-------------|
| Francis A. Sharpton        | USE 8853288 |
| Northwest Nazarene College | \$14,814    |
| Nampa, ID                  | Physics     |

**"Laboratory Modernization of Undergraduate Experimental Physics Laboratories"**

The equipment funded by this award includes six high-speed oscilloscopes, a high-resolution gamma-ray spectroscopy system, and an X-ray spectroscopy system. This equipment is used to improve instruction in both lower- and upper-division Physics laboratory courses. Courses affected include a microcomputer interfacing laboratory and a spectroscopy laboratory. In addition, the equipment is used by upper-division physics majors for required individual projects.

The grantee is matching the NSF award with an equal amount of funds from non-Federal sources.

|                             |             |
|-----------------------------|-------------|
| Harold B. Hart              | USE 8851438 |
| Western Illinois University | \$13,254    |
| Macomb, IL                  | Physics     |

**"Computerization of Introductory Physics Laboratories"**

This award funded the purchase of six air track systems, six photogate systems, six rotational dynamics systems, six



measurement interfaces, and six microcomputers. This equipment is used to improve instruction in Introductory Physics laboratory courses. Physics and pre-engineering students receive a systematic introduction to the laboratory applications of microcomputers including data acquisition, instrument control, data analysis, and data display.

The grantee is matching the NSF award with an equal amount of funds.

|                               |             |
|-------------------------------|-------------|
| Arthur B. Western             | USE 8851289 |
| Rose-Hulman Institute of Tech | \$41,788    |
| Terre Haute, IN               | Physics     |

**"Modern Optical Instrumentation and Holography Laboratories for a New Undergraduate Program in Applied Optics"**

The Physics Department is purchasing optics equipment for six new undergraduate laboratories established to support a newly instituted Bachelors Degree in Applied Optics. Particular emphasis is placed on laboratories for Optical Instrumentation and Holography.

This award is being matched by an equal sum from the grantee.

|                             |             |
|-----------------------------|-------------|
| Roger J. Hanson             | USE 8852598 |
| University of Northern Iowa | \$10,180    |
| Cedar Falls, IA             | Physics     |

**"Improvement of Undergraduate Acoustics Laboratory Instruction"**

The grantee institution is equipping a laboratory with a dual-channel, real-time spectrum analyzer, x-y recorder, calibrated sound power source, and an integrating sound level meter. This equipment is used to improve instruction in acoustics courses both for Physics majors and non-majors. The spectrum analyzer is used to examine phase differences between different parts of sound systems, and to look at the dynamic structure of sound spectra. The calibrated sound power source permits several new experiments to be added to the courses, and the sound level meter is used to analyze noise sources. Advanced undergraduates are also able to use the new equipment in research projects.

The grantee is matching the NSF award with an equal amount of funds.

|                          |             |
|--------------------------|-------------|
| Robert L. Sauer          | USE 8852367 |
| University of Kentucky   | \$14,898    |
| Hazard Community College | Physics     |
| Hazard, KY               |             |

**"Integrating the Microcomputer into Introductory Physics Laboratories"**

The grantee is developing a laboratory, including a complement of scientific and computational equipment, to im-

prove instruction in Introductory Physics laboratory courses. The equipment, which includes air tracks, oscilloscopes, function generators, microcomputer interfaces, sensors, and motion transducers allows students to obtain "hands-on" experience in the use of modern techniques for data acquisition and analysis. The improved speed and accuracy achievable with this equipment permits students to explore a wide range of basic physical phenomena, and helps them gain greater understanding of the underlying physical principles.

The grantee is matching this NSF award with an equal amount of funds.

|                 |             |
|-----------------|-------------|
| John E. Smedley | USE 8851997 |
| Bates College   | \$13,515    |
| Lewiston, ME    | Physics     |

**"Microcomputer-based Undergraduate Experiments in Laser Spectroscopy and Atomic Collision Phenomena"**

Exposure to modern instrumentation and techniques are essential to the development of today's Physics major and tomorrow's physicist. The Physics Department is introducing new microcomputer-interactive experiments in laser spectroscopy and atomic collision phenomena into the laboratory program. The experiments involve advanced students in independent study and senior thesis projects. The apparatus is also used in the sophomore level Laboratory Physics course, which is required of all Physics majors.

The award is being matched by an equal sum from the grantee.

|                    |             |
|--------------------|-------------|
| Stuart B. Crampton | USE 8851881 |
| Williams College   | \$32,690    |
| Williamstown, MA   | Physics     |

**"Instrumentation for Precision Time Transfer in Undergraduate Physics and Astronomy Laboratories"**

The Department of Physics and Astronomy is developing a laboratory that can receive and study time and frequency signals from Global Positioning Satellite transmitters. An existing atomic hydrogen maser frequency standard provides a stable frequency reference for comparing signals from different satellites and for comparing via computer link the satellite signals received at Williamstown, MA, and at the National Bureau of Standards in Boulder, CO. Applications to navigation and solar system ranging and to time and frequency transfer between remote sites illustrates the power of this new technology and its value to science. The telemetry technology is studied using the re-

ceiver's own diagnostic displays. Special teaching laboratory modules using this equipment illustrate the fundamental properties of space and time that students in Introductory Physics courses have been learning in class and introduces them to state-of-the-art technology. The equipment provides a basis for a new course designed to introduce students not intending a science major to modern notions of space and time and their relationship to modern technology. The equipment is also used by Senior Honors and other students doing research projects with this institution's experimental low temperature atomic hydrogen maser.

In addition to matching the NSF support, participants are contributing approximately 15% additional funding toward the costs of the program.

Ned C. Rouze  
Hope College  
Holland, MI

USE 8852136  
\$8,535  
Physics

#### **"Verification of the Uncertainty Principle: an Expanded Advanced Laboratory Course"**

This project adds an experiment to the Advanced Physics Laboratory course to verify the time-energy uncertainty relation and lifetime of an excited level of iron. The uncertainty in energy of the level is measured using the Mossbauer effect which allows the natural linewidth of the emitted gamma rays to be determined using the Doppler effect and resonant absorption. The uncertainty in lifetime is determined by measuring the time between the production and decay of the same nuclear level using fast electronic components.

The equipment used for this investigation is also used for general improvements to the Advanced Laboratory course. In particular, the nuclear Zeeman effect is studied using the Mossbauer apparatus with a ferromagnetic absorber in which the nuclear levels are split by an internal magnetic field produced by the electronic motion.

The grantee is matching the NSF funds with an equal amount of non-Federal funds for this project.

Jan Tobochnik  
Kalamazoo College  
Kalamazoo, MI

USE 8851210  
\$13,750  
Physics

#### **"Computer Simulation Laboratory for Undergraduate Thermal Physics and Introductory Physics"**

Five high-speed scientific workstations funded by this award are being used to improve instruction in the upper-division Thermal Physics course and in the Introductory Physics sequence. Molecular dynamics and monte carlo

simulation techniques are introduced in the Thermal Physics course. In the introductory courses the workstations are used to simulate simple, but nonlinear, mechanical systems, and for electrostatics simulations.

The grantee is matching the NSF award with an equal amount of funds.

Brian J. Anderson  
Augsburg College  
Minneapolis, MN

USE 8852403  
\$17,146  
Physics

#### **"A High Vacuum Laboratory for Undergraduate Instruction"**

High vacuum technology underlies much of current experimental science and "high technology," and provides an excellent basis for training advanced undergraduates. The Physics Department is installing a high vacuum laboratory featuring four multipurpose vacuum stands (medium-high-vacuum, gas analysis with mass spectrometry, gas mixing, and ultra-high-vacuum), and is continuing ongoing curriculum developments related to this laboratory. Experiments include topics in atomic and molecular properties using mass spectroscopy, plasma physics, gas-surface interactions, and vacuum technology. The equipment purchased includes a modern quadrupole mass spectrometer, PC-based computer controllers and computer-compatible sensors, and selected vacuum items needed to complete stand fabrication. The vacuum laboratory is used by both Physics and Chemistry students in several upper division courses, and by technical employees in local industry enrolled as part of an ongoing educational partnership.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Donald R. Morgan  
St Mary's College  
Winona, MN

USE 8851415  
\$8,300  
Physics

#### **"Modernization of Optics Experiments in Advanced Undergraduate Labs"**

This project includes purchase of an optical bench, a 5 mW He-Ne laser and associated optics, a photodiode array, an interferometer system, a fiber optic system, and a holographic system. This equipment is used to improve instruction in the Advanced Physics Laboratory course by permitting the addition of several new experiments in modern optics. These experiments are designed to give students training in the use of modern optical equipment as well as improving their understanding of the basic physical phenomena.

The grantee is matching the NSF award with an equal amount of funds.

Evelyn Stephens  
SUNY Fashion Institute of Tech  
New York, NY

USE 8852778  
\$22,125  
Physics

Daniel B. Caton  
Appalachian State University  
Boone, NC

USE 8852993  
\$100,000  
Astronomy

**"Color and Light: Education in Applied Physics at the Fashion Institute of Technology"**

This project upgrades and expands instruction in color science in nine associate and baccalaureate degree programs at this institution, a community college of the State University of New York. The understanding of color in scientific terms is an essential part of the professional education of a growing number of full and part-time students at F.I.T. who prepare for careers in fashion and its related industries and professions. Beyond the need for professionally relevant education, the college is committed to the importance of providing hands-on experimentation in up-to-date laboratories to enable a wide variety of students to understand, first-hand, the rigors, creativity, and excitement of modern scientific inquiry. The acquisition of a computer-driven spectrophotometer with appropriate software and plotter, portable colorimeters, and dyeing equipment is upgrading laboratory instruction, reducing student frustration with failure of old equipment and increasing the range of experiments students will perform. This project strengthens the F.I.T. model of integrating professional education with relevant instruction in basic sciences, mathematics, and liberal arts.

This award is being matched by an equal sum from the grantee.

Milan C. Buncick  
Appalachian State University  
Boone, NC

USE 8852985  
\$22,398  
Physics

**"Thin Film Deposition and Etching Facility for Undergraduate Physics"**

The grantee institution is installing a high-vacuum pumping station, an radio-frequency/direct-current sputtering system, and an electron beam evaporation and etching system. This equipment is used to improve instruction in upper-division Physics laboratory courses. Experiments in vacuum technology and thin film properties are introduced, and microstructures fabricated with the equipment are used in new experiments in opto-electronics. Advanced undergraduate students also use the equipment for individual projects.

The grantee is matching the NSF award with an equal amount of funds.

**"A Modern Technology Telescope for Undergraduate Student Projects and Research"**

This award permits the installation of a modern telescope that incorporates many advanced technology features for use by undergraduate Physics/Astronomy majors. These students use the telescope to learn research techniques in observational astronomy and also acquire valuable original scientific data. Students make their own observations, analyze the data, and prepare the results for publication. In addition, they learn first-hand the operation of modern astronomical instrumentation.

The telescope is installed at Appalachian State University's Dark Sky Observatory, located in the mountains of western North Carolina. The telescope is equipped with a variety of auxiliary instruments including a photometer to measure the brightness of variable stars and a CCD video camera to acquire images of stars, galaxies, quasars, and comets. A spectrograph is used to obtain stellar spectra of sufficient quality to determine a star's spectral type (temperature and size).

Observations and instrument control are done remotely from a warm-room in much the same style as modern research observatories. Students also explore the possibility of remote control of the observatory, from campus, via telecommunications. Thus, the newer and larger telescope not only replaces the function of the obsolete telescopes currently at the site, but it also takes a step forward into the next generation of telescope instrumentation.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Jose J. D'Arruda  
Pembroke State University  
Pembroke, NC

USE 8852017  
\$14,665  
Physics

**"Contemporary Data Acquisition Methods in Science Laboratories"**

This project provides for purchase of microcomputers, associated computer peripherals, and physics apparatus. This equipment is used to improve instruction in the Introductory Physical Science Laboratory course. The students, many of whom are prospective teachers, learn the fundamentals of computer assisted data acquisition and analysis.

The grantee is matching the NSF award with an equal amount of funds.



|                              |             |
|------------------------------|-------------|
| Robert G. Aitken             | USE 8852056 |
| University of North Carolina | \$10,265    |
| Charlotte, NC                | Physics     |

**"Raman Spectroscopy for an Undergraduate Solid State Physics Laboratory"**

In order that existing Solid State Physics lecture and laboratory courses may be kept abreast of new developments, the Physics Department is adding a Raman spectroscopy experiment to the laboratory course. This adds capability in the optical study of solids and builds upon the modest amount of optical equipment which already exists. The instrumentation can be enhanced later to add experiments involving other optical techniques such as Brillouin scattering and fluorescence.

The grantee is matching the award from non-Federal sources.

|                    |             |
|--------------------|-------------|
| Shila Venkataraman | USE 8851515 |
| College of Wooster | \$20,835    |
| Wooster, OH        | Physics     |

**"A Laser Optics Laboratory for Undergraduate Projects"**

An optical laboratory illustrates advanced concepts in Optics, allow testing of the theories developed in courses, and provides crucial experimental techniques for probing condensed matter systems. All students are required to perform a year-long research project in their senior year. An extended investigation allows students to integrate material from a variety of courses and labs and provides an essential example of their profession. This grant allows a new technique to be available for student research—laser light scattering. By providing a series of optics experiments in modern Physics and junior independent study, the students are able to use static and dynamic light scattering as a probe of many physical systems currently of interest to the scientific community. The acquisition of a 5 W Argon ion laser, a vibration isolated optics table, laser amplitude stabilizer and several optical components allow undergraduates to investigate fundamental molecular processes and to do holography in laboratory courses and in senior independent study projects.

The grantee matching the NSF award with an equal amount of funds.

|                    |             |
|--------------------|-------------|
| R. Lester Anderson | USE 8852995 |
| Marietta College   | \$30,500    |
| Marietta, OH       | Physics     |

**"Using Sensors and Microcomputers to Simplify the Learning of Concepts in the Introductory Physics Laboratory"**

The laboratory funded by this award consists of electronic sensor sets, rotational dynamics apparatus sets, mi-

crocomputers and associated peripherals and software. This equipment is used to improve instruction in lower-division Physics Laboratory courses. Improvements are being made to nine basic experiments in these courses, and students have the opportunity to enhance their understanding of the underlying physical phenomena through the use of modern sensing equipment and data analysis techniques.

The grantee is matching the NSF award with an equal amount of funds.

|                           |             |
|---------------------------|-------------|
| Daniel E. Beeker          | USE 8852433 |
| Northeastern Oklahoma A&M | \$20,872    |
| Miami, OK                 | Physics     |

**"Computers in the Undergraduate Physics Laboratory"**

This project incorporates computers into the undergraduate Physics and Pre-Engineering Laboratories. Students use the computers for data acquisition as well as for analysis and presentation of the data. Experiments have been modified from those previously available for manual data acquisition to use the computer in the data acquisition process. Software and computer orientation for experimental work is presented to assist students in using the laboratory more effectively.

The grantee provides funds for this project that are an equal match for the NSF award.

|                         |             |
|-------------------------|-------------|
| John C. Abele           | USE 8851283 |
| Lewis and Clark College | \$26,927    |
| Portland, OR            | Physics     |

**"Solid State Laboratory for Advanced Undergraduate Physics Students"**

The Physics Department is developing a modern laboratory for teaching Solid State Physics. Building on a base of introductory and intermediate courses, the Physics faculty has recently turned its attention to the development of a series of advanced laboratory/student-faculty research investigations which serve to emphasize topics being studied in Thermodynamics and Statistical Mechanics, Modern Physics, Solid State Physics and Quantum Mechanics.

Solid State Physics was selected to illustrate fundamental interactions of electrons with matter. The development of this laboratory is also very practical in view of the graduate and career plans of undergraduate Physics majors. The laboratory supports a range of experiments of differing degrees of sophistication. A number of pieces of equipment for crystal growth and electrical and optical measurements are available.

The central piece of equipment in this project is a superconducting magnet and variable temperature cryostat

used to investigate fundamental properties of materials. The system is capable of temperatures from 1.5 to 300 Kelvin and magnetic fields up to ten Tesla. This system is used by students enrolled in Advanced Laboratory, Undergraduate Research, or student-faculty collaborative research. Examples of concepts studied are: magnetic susceptibility, specific heat, electrical conductivity, Landau quantization, electronic band structure, superconductivity, and semiconductor carrier concentration.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

J. W. Powell  
Reed College  
Portland, OR

USE 8851509  
\$93,831  
Physics

#### **"An FTIR Spectroscopy Laboratory for Teaching and Undergraduate Research"**

This award funds a spectroscopy laboratory so that undergraduate Physics majors can employ the powerful techniques of Fourier transform infrared spectroscopy in laboratories at the senior, junior, and sophomore levels. The flexible research-quality Bruker IFS 113V spectrometer provides the equipment necessary for senior Physics majors to complete their required thesis in at least two fields of solid state spectroscopy: transmission measurements on nucleic acids and reflection measurements on high temperature superconductors. The instrument is also used for experiments in the Advanced Laboratory and for demonstrations and limited hands-on experience in the sophomore laboratory. The instrument provides excellent preparation of Physics majors for graduate work in Experimental Physics. In particular, the spectrometer provides students with the opportunity to undertake advanced experiments and research projects, leading to talks at professional meetings. On a broader scale, this project establishes a serious undergraduate Experimental Physics program on the campus.

The grantee is matching the award from non-Federal sources.

Vythilingam Wijekumar  
Indiana University of Penn  
Indiana, PA

USE 8851861  
\$10,399  
Physics

#### **"CAMAC (Computer Automated Measurement and Control) Based Data Acquisition System for the Undergraduate Nuclear Physics Laboratory"**

The Physics Department improved the undergraduate Nuclear Physics curriculum by giving students hands-on experience in the latest state-of-the-art technology in real-

time data acquisition, monitoring and control that is used not only in the area of Nuclear Physics, but also in the chemical industry and in the medical field. The purchase of a CAMAC system is the first step toward this goal. This system includes a CAMAC crate, a crate controller, three CAMAC modules (analog to digital converters) and an IBM PC/AT compatible PC with associated software for data acquisition. The CAMAC system is used in the advanced undergraduate Physics laboratory to acquire, monitor and control data in nuclear physics experiments. Since this system has found widespread use in industrial, research and medical applications, this equipment better prepares undergraduate Physics students for graduate school and industry.

This award is being matched by an equal amount from this institution.

Gordon C. McIntosh  
St Vincent College  
Latrobe, PA

USE 8852767  
\$5,361  
Astronomy

#### **"Computer Interfacing with Radio and Optical Astronomical Telescopes"**

The grantee acquired three Apple-IIIGS Systems and a mounting for an existing 25 cm optical telescope. The computers are interfaced with the optical telescope and an existing 5 meter radio telescope for control of telescope positioning and acquisition and analysis of data. In addition to student research and advanced laboratory courses, activities using the telescopes are being developed for application in the Introductory Astronomy, General Physics and Electronics courses offered by the Department of Physics.

The grantee is matching the NSF award with an equal amount of funds.

Richard W. Kozlowski  
Susquehanna University  
Selinsgrove, PA

USE 8851978  
\$7,123  
Physics

#### **"Fiber Optics and a Sophisticated Spectrometer in an Undergraduate Physics Program"**

This project provided for purchase of fiber optics kits and components for the construction of an optical spectrometer. This equipment is used to improve instruction in the upper division Physical Measurements Laboratory. The spectrometer is specially designed for teaching Spectroscopy. Students use the fiber optics equipment to gain a basic understanding of this new technology, while the optical spectrometer is used to instruct students in the basic principles underlying this widely used type of instrument.

The grantee is matching the NSF award with an equal amount of funds.

Frank A. Moscatelli  
Swarthmore College  
Swarthmore, PA

USE 8852201  
\$30,964  
Physics

#### **"Laser Atomic/Molecular Spectroscopy Laboratory for Undergraduate Instruction"**

The Physics Department is developing a laser atomic molecular spectroscopy laboratory for undergraduate instruction. The facility includes a pulsed tuneable dye laser, a boxcar averaging system for time resolved detection, a tuneable CW laser, a double spectrometer for recording high dispersion spectra, and provisions for upgrading an existing apparatus as a versatile atomic beams device. The laboratory makes extensive use of computer interfacing and control. Activities in the lab cover a wide range such as: simple demonstrations and observations; routine experiments associated with advanced courses; and student research projects and theses. Typical experiments include Raman spectroscopy, investigations of the optogalvanic effect, atomic and molecular life time measurements, non-linear spectroscopy, Doppler free atomic beam spectroscopy, two-step excitation of Rydberg atoms, and observations of coherent transient phenomena.

The grantee is matching the NSF award with an equal amount of funds.

Karel V. Lugt  
Augustana College  
Sioux Falls, SD

USE 8851445  
\$13,630  
Physics

#### **"Undergraduate Laboratory Station for the Synthesis and Analysis of Sound"**

This award funded the purchase of an audio fast Fourier analysis system, a digital sampling synthesizer, and a Macintosh II microcomputer system with associated software. This equipment is used to improve instruction in Physics courses for majors and non-majors by allowing students to carry out experiments in the synthesis and analysis of sound. Physics students use the equipment in an advanced laboratory course, while non-majors (including special education and speech therapy students) use the equipment in Introductory Physics laboratories and in a special course on the analysis and synthesis of sound.

The grantee is matching the NSF award with an equal amount of funds.

Gerald R. Taylor, Jr.  
James Madison University  
Harrisonburg, VA

USE 8851396  
\$11,600  
Physics

#### **"Computer Interfacing for Advanced Undergraduate Physics Laboratories"**

The grantee purchased two microcomputer-based control and data acquisition systems, a digital picoammeter, two autoranging digital multimeters, and a bipolar power supply/amplifier. This equipment is used to improve instruction in upper-division Physics Laboratory courses, and is also used by advanced undergraduates in independent research projects. Students control and analyze data from selected modern Physics experiments as well as in some newly developed plasma physics experiments.

The grantee is matching the NSF award with an equal amount of funds.

Walter Wimbush  
No. Virginia Comm College  
Alexandria, VA

USE 8851740  
\$10,780  
Physics

#### **"Microcomputer as a Learning Tool in the Undergraduate Physics Laboratory"**

The use of a computer as a laboratory instrument is fast becoming a standard within the undergraduate Physics laboratory. It is important, however, that the computer not be used to merely mechanize data gathering and analysis, virtually replacing the student in the lab and leaving him/her as a passive agent. This project develops innovative ways to use the computer to allow the student to have a deeper intellectual experience in the lab. Using commercially available computer interfaces, the students are instructed in the use of the computer hardware and software. They then are encouraged to devise variations of standard undergraduate Physics labs using the computer to acquire the data and then to analyze the data.

The computers are interfaced with airtracks and photo-reflective sensors, as well as with existing transducers and sensors.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

Richard Feinberg  
Western Washington Univ  
Bellingham, WA

USE 8851148  
\$10,422  
Physics

#### **"Instrumentation for an Undergraduate Laser Spectroscopy Laboratory"**

The grantee has acquired instrumentation which provides students in Optics Concentration with hands-on ex-



posure to modern methods of laser spectroscopy, optical detection, signal processing, and computer-based data acquisition.

The Physics Department purchased a PRA LN120C2 Combination Nitrogen/Dye Laser System, a Stanford Research Systems Model SR400 Gated Photon Counter, and an IBM PC/XT Compatible Computer.

These instruments form a versatile combination which enable the students to perform a wide variety of laser spectroscopy experiments in absorption, fluorescence, Raman, opto-acoustic, opto-galvanic, and photothermal deflection spectroscopy. In addition, the nitrogen/dye laser system serves as a teaching tool for the study of these important laser types.

This project is significant because it brings to the undergraduate laboratory devices and techniques which are routinely used in graduate, government, and industrial research laboratories. It enables students to understand and utilize laser spectroscopic techniques for the analysis of matter at an earlier stage of their careers. Finally, it serves other institutions through the publication of student lab experiments which will be developed.

The grantee is matching the NSF award with an equal amount of funds.

David M. Cook  
Lawrence University  
Appleton, WI

USE 8851685  
\$49,433  
Physics

#### **"Scientific Workstations in Undergraduate Physics"**

Sophisticated scientific workstations running powerful software are essential tools for practicing scientists and engineers, but undergraduate curricula nationwide are not responding vigorously to the challenge and opportunity provided by these devices. In response, the Department of Physics constructed a computation laboratory to support a major restructuring of its undergraduate Physics curriculum. The first phase of this project builds familiarity with computer-based tools by introducing suitable examples and exercises into the intermediate-level core of courses. As the students advance, more sophisticated exercises are incorporated into advanced offerings. Through curricular revision, a departmental environment is created within which undergraduates become expert at using state-of-the-art computing tools intelligently, effectively, extensively, and independently. At the same time, the Department is conducting a pilot project whose results will influence the course of Physics instruction at other schools during the coming decades.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

## **PSYCHOLOGY AND SOCIAL SCIENCES**

Jerome E. Young  
Wayne Poniewaz  
University of Arkansas  
Monticello, AR

USE 8851143  
\$10,690  
Social Science

#### **"Acquisition of Behavioral Science Laboratory Equipment"**

Computers, ancillary equipment and software are provided to establish a behavioral science computer laboratory for courses in political science, psychology, and sociology in the Department of Social and Behavioral Sciences. The laboratory provides social science majors, nonscience majors, and future secondary school teachers with hands on experience in the use of microcomputers and exposure to the scientific and technical aspects of the social sciences. Ten microcomputers and associated hardware, disc drives monitors, and four printers, are provided. Software includes a statistical package, data sets covering a wide range of topics in domestic and foreign affairs, and experiments designed for interactive student use. Students apply behavioral science concepts and methodologies to real data sets, become familiar with contemporary statistical packages,

manipulate variables in relation to classic experiments, and design their own research projects.

The award will be matched by an equal amount from the grantee.

Ralph J. Charkins  
California State Col  
San Bernardino, CA

USE 8853029  
\$36,970  
Economics

#### **"A Computer-Based Undergraduate Economics Curriculum"**

Economics is a difficult subject to learn. Undergraduates often fail to grasp the fundamental concepts and relationships of the discipline and seldom develop the basic skills of economic analysis. The three major reasons for this are the mathematical nature of the discipline, the perceived abstract nature of the subject, and the level of statistical sophistication necessary to perform even fairly simple analysis.

This project exploits the educational capabilities of the microcomputer to minimize these obstacles. Software and

data bases tailored to the level of sophistication of the students are used in a twentyone workstation laboratory purchased by this award for the introductory courses, four specialized upper division courses, and, in the future, the bulk of the remaining upper division courses. In addition, an entirely new course has been developed using the work stations. Drill and practice are avoided and economics skills are developed throughout the entire undergraduate economics curriculum.

The award will be matched by an equal sum from the grantee.

Richard A. McFarland  
California State University  
Fullerton, CA

USE 8851875  
\$23,308  
Psychology

#### **"Improvement of Instrumentation and Instructional Format in Physiological Psychology"**

This project provides five physiological recording instruments for 120 students per semester in six laboratory sections of a course in Physiological Psychology. The study of the physiological bases of behavior requires accurate monitoring and recording of physiological responses. The equipment provided for this project allows the upper division undergraduate students to gain the necessary hands on experience to grasp the relationship between biology and behavior and to understand the techniques by which these relationships are discovered. When not needed for the Physiological Psychology classes, the equipment is employed in demonstrations in the Introductory Psychology classes and Research Methods classes. In addition, the equipment significantly increases the quantity and quality of independent research projects carried out by undergraduate students doing research in Physiological Psychology.

The award will be matched by an equal amount from the grantee.

Dina L. Anselmi  
Trinity College  
Hartford, CT

USE 8853242  
\$5,442  
Psychology

#### **"Developmental Psychology Lab Improvements"**

This Developmental Psychology project studies the perceptual, cognitive, and social behavior of infants and children using a variety of techniques. The methods include naturalistic observation, correlation, and experimentation. Behavior is recorded on video tape, observations are coded and entered into a computer for analysis.

The award upgrades the existing Developmental Psychology laboratory with a video camcorder, a remote con-

trol video system, a personal computer and printer, and ancillary equipment. Students at the introductory and advanced levels, the majority of whom are women, participate in research studies where they receive hands on experience testing young children. The additional equipment enables students to study a wide range of developmental questions and learn a variety of data collection techniques as well as learning up to date statistical and computer programming skills.

The grantee institution is matching the NSF award with an equal sum obtained from non-Federal sources.

George H. Stopp, Jr.  
University of West Florida  
Pensacola, FL

USE 8852720  
\$9,554  
Geography

#### **"Enhancing Computerized Cartographic Instruction in an Undergraduate Geography Program"**

This project establishes a capability in computer assisted cartography in the Geography program. Computer assisted cartographic techniques and processes are an integral part of several undergraduate geography courses, significantly enhancing the level of learning among both geography majors and other students who look to Geography as a corollary science to their major discipline. In addition to integration of the equipment into four technique courses, computer assisted cartography is introduced as a discrete learning unit into the entire array of geography courses, thus serving a wide audience from the entire University. The goal is to provide students with an opportunity for hands-on experience with computer assisted cartographic techniques and to allow them to participate in the expanded geographic analytic processes associated with these techniques. The award will be matched by an equal amount from the grantee.

Kathryn Kamp  
Grinnell College  
Grinnell, IA

USE 8851417  
\$7,662  
Anthropology

#### **"Computerization of Archaeological Mapping in Field School and Field Methods Classes"**

An electronic theodolite coupled to an electronic distance meter, a small hand held computer and a field printer, subsequently interfaced with the field laboratory micro-computer, enhance the ability of students to participate in the analysis of data in an archaeological field school context. The same equipment, by increasing the efficiency of data collection, allows on campus students in an Archaeological Field Methods class to map data for the more satisfactory completion of research projects.

The award is being matched by an equal sum from the grantee.

Georgia N. Nigro  
Drake R. Bradley  
Bates College  
Lewiston, ME

USE 8852194  
\$44,287  
Psychology

**"Networking the Classroom and Microcomputer Laboratory to Enhance Undergraduate Training in Psychology"**

This project makes microcomputer technology a central part of the undergraduate experience in Psychology. It establishes an interactive classroom and two computer laboratories. The interactive classroom is equipped with a microcomputer, a video recorder, and a multi-sync video projection system for effective in-class demonstrations of microcomputer applications. The statistics laboratory enables the conduct of laboratory assignments requiring data analysis and simulation, and the on line laboratory permits the on line control of experiments. The classroom and laboratory microcomputers are networked in order to provide the advantages of a mainframe system without the corresponding limitations.

Undergraduates are involved in all phases of the use of microcomputer technology in research, data acquisition, on line experimental control, data retrieval, data analysis, bibliographic work, report writing, graph making, and simulation. Student proficiency in using microcomputers is a means to deeper understanding of basic psychological principals as well as an end in itself.

The award will be matched by an equal sum from the grantee.

Jerry A. Eberhart  
Carleton College  
Northfield, MN

USE 8851171  
\$63,936  
Psychology

**"Neuroscience Laboratory (Psychology)"**

In response to the growing importance of neuroscience research in the behavioral sciences, a neuroscience laboratory has been established for teaching in Psychology. Laboratory experience at all levels of the undergraduate social science curriculum is offered from freshman seminars to advanced seminars and independent research projects. The core of this project is a new upper level course, Laboratory in Physiological Psychology, which provides instruction in modern neuroanatomical methods. This project requires equipment for preparation of animals, for histological processing of neural tissue, and for analyzing and recording the resulting material. Thus, the equipment

includes operating microscopes for surgery, a sliding microtome to cut frozen sections, and compound microscopes equipped to observe and record fluorescent tracers. This facility complements the college's molecular neuroscience facility in Biology and makes available comprehensive neuroscience laboratory courses.

The award will be matched by an equal amount from the grantee.

Walter D. Mink  
Macalester College  
Saint Paul, MN

USE 8851719  
\$13,304  
Psychology

**"Computer Laboratory for Cognitive Science Information"**

Necessary hardware and software has been assembled to provide laboratory support for a new course, Introduction to Cognitive Science. Cognitive Science is a set of problems common to the disciplines of Psychology, Linguistics, Philosophy, and Artificial Intelligence. A strong role is played by computing in this emerging multidisciplinary enterprise and a strong laboratory component is essential to an introductory course. A cluster of four computer workstations, a laser printer, and the means to link them into an integrated system as well as to tie them into a campus wide network have been provided by the award.

The award will be matched by an equal sum from the grantee.

Paul F. Brown  
Mankato State University  
Mankato, MN

USE 8853333  
\$11,456  
Anthropology

**"Establishment of a Physical Anthropology Laboratory"**

Laboratory training is a fundamental aspect of good physical anthropology training. This award permits the purchase of needed equipment for a new physical anthropology laboratory. The courses utilizing this equipment include, Introduction to Anthropology, Human Origins, Human Skeleton, Health Culture and Disease, and Physical Anthropology Laboratory. The pathology material is used in the areas of pathological processes of bone and forensic analysis. The skeletal material is used for identification of parts of the skeleton and the landmarks and features of individual bones. The microscopes are used for the study of bone histology. The anthropometric instruments are basic tools required for anthropometry. They are used to demonstrate variability by age, sex, and breeding population.

The award is being matched by an equal amount from the grantee.



James F. Dickson  
St Olaf College  
Northfield, MN

USE 8851795  
\$18,106  
Psychology

#### **"Development of Interactive Laboratory-Classroom in Psychology"**

This project establishes an interactive microcomputer laboratory classroom in Psychology. It impacts all majors in Psychology, exposing students to the use of the microcomputer as an integral part of the research enterprise in Psychology.

Student experiences include the use of microcomputers for programming of experimental contingencies, stimulus presentation, data collection and statistical analysis with human and animal subjects. For those phenomena which cannot be directly studied, simulation programs are used. Twelve microcomputers and ancillary equipment serve a variety of courses and over 100 students per year.

The laboratory is available for advanced student research projects as well. The provision of software for sharing information and documents should impress students with the many effective alternatives for developing research ideas, exchanging experimental data and communicating the results of their research investigations. This new facility represents a critical and significant new direction in the Psychology program.

The award will be matched by an equal sum from the grantee.

David J. Hartmann  
Southwest Missouri State Univ  
Springfield, MO

USE 8852039  
\$12,576  
Social Science

#### **"The Social Science Research Laboratory"**

The Department of Sociology, Anthropology and Social Work has developed a social research curriculum and a Center for Social Research. The curriculum and Center provide opportunities for social science students to conduct field and laboratory research preparing them for careers as researchers, teachers and advisors and as scientifically literate citizens. The computers, printers and software funded by this award are used throughout the curriculum to foster methodological rigor and analyze real world data.

The award will be matched by an equal amount from the grantee.

Stephen F. Bollinger  
Jackson State University  
Jackson, MS

USE 8852929  
\$7,130  
Psychology

#### **"Microcomputer Assistance to Upgrade Physiological Psychology, Experimental Psychology and Statistics"**

This project enriches the research experience of psychology students in Physiological Psychology, increases the

sophistication of data analysis and experimental simulations in Experimental Psychology and assists the learning of statistics with supplemental computer assisted instruction. The equipment acquired, including microcomputers and instructional software, supports analogue to digital conversion, computerized data acquisition and signal averaging. With this award, an increased number of undergraduate students are being encouraged to pursue graduate education leading to academic and/or research careers in Psychology. Worthwhile research experiences and rigorous training in the basics of statistics and experimental design are vital to motivating and training students pursuing graduate education. The institution has a more than ninety percent minority enrollment.

This award will be matched by an equal sum from the grantee.

Lawrence G. Kolenbrander  
Bruce D. Idleman  
Western Carolina University  
Cullowhee, NC

USE 8851879  
\$38,367  
Geography

#### **"Geographic Information System Laboratory for Undergraduate Instruction"**

A Geographic Information System (GIS) Laboratory is established to improve the quality of undergraduate instruction in the Natural Resources Management and Earth Sciences Programs. The laboratory includes three workstations, ancillary hardware and GIS software in two formats (vector-based and raster-based) in common use. Junior and senior level students are applying GIS to problems in the fields of Natural Resources Management, Geology, Geography and Planning. GIS is used to obtain and manipulate special information, and the interpretation and synthesis of this information. GIS allows students to address research problems that normally require inordinate amounts of time and effort to answer using traditional techniques of special analysis such as manual overlays. The use of GIS technology is becoming increasingly common in the fields affected by this award. This new laboratory enhances the problem solving, research, and professional capabilities of graduates from the respective programs.

The award will be matched by an equal sum from the grantee.

William J. Wozniak  
Kearney State College  
Kearney, NE

USE 8852068  
\$11,312  
Psychology

#### **"Computer Laboratory in Human Experimental Psychology"**

The Psychology Department curricula are advanced by the establishment of a computer laboratory in human ex-

perimental psychology. A network of personal computers is used in teaching the research process and in the application of the research process in laboratory courses. The beneficiaries of the proposal are: (a) traditional Psychology majors, who are required to participate in a three or four semester sequence of research courses, and (b) Human Factors and Psychobiology majors, who have special requirements in research. The proposal has direct impact on these students through the following courses: Research Methods, Experimental Psychology, Human Learning and Memory, Sensation and Perception, Physiological Psychology, Experimental Life-Span Psychology, and Human Cognition.

The award will be matched by an equal amount from the grantee.

Lowell A. Roberts  
Gary Bonitatibus  
Saint Anselm College  
Manchester, NH

USE 8852967  
\$18,502  
Psychology

#### **"Instrumentation for Instruction and Research in Psychophysiology"**

This project updates the curriculum in Psychology involving computer applications linked to scientific equipment. It serves instructional and research needs of the Psychology Department. The new equipment replaces outdated and non-operational existing equipment. It enables classroom instruction and student research in Psychophysiology, with the new four channel recorder of psychophysiological data. Undergraduate education is further enhanced by incorporating the application of computer technology with modern psychophysiological recording techniques.

The award will be matched by an equal sum from the grantee.

Samuel S. Harrison  
Allegheny College  
Meadville, PA

USE 8851340  
\$11,900  
Environmental Science

#### **"Water Analysis Laboratory for Undergraduate Instruction"**

The Water Analysis Laboratory is used by undergraduates for coursework in Water Analysis, required of Environmental Science majors. The central piece of equipment in this laboratory is an atomic absorption spectrophotometer. Use of this instrument is essential for students learning the application of basic Chemistry to the study of environ-

mental problems. Many of the student senior research projects in Environmental Science, as well as in Biology and Geology, rely on atomic absorption spectrophotometry as the primary means of collecting data by conducting chemical analyses of water, rock, soil, plant and animal samples.

The grantee provides funds for this project that are an equal match for the NSF award.

Norman M. Whalen  
Southwest Texas State  
San Marcos, TX

USE 8852746  
\$9,684  
Anthropology

#### **"Scientific Instruments for Undergraduates in Archaeology and Physical Anthropology"**

The scientific equipment provided by this award enhances the quality of introductory and advanced courses in Archaeology and Physical Anthropology by enabling undergraduate students to experience hands on use of instruments in the classroom, laboratory and field program settings. Two surveying instruments, a theodolite and an alidade, greatly improve student competence in field situations involving archaeological surveying and mapping and expand the range of their performance to include skill in the use of equipment common to Old World as well as New World archaeology. The microscopes provide laboratory opportunity for students to observe and identify cellular structure and histology of bone tissue and the nature of wear patterns on hominid teeth. Physical anthropology students use the calipers and microscope provided to measure and examine specimens in the search to identify and distinguish different species of human and nonhuman primates.

The award will be matched by an equal amount from the grantee.

Stuart M. Glosser  
University of Wisconsin  
Whitewater, WI

USE 8852274  
\$72,714  
Economics

#### **"Economics Computer Laboratory"**

This project establishes an Economics Computer Laboratory. The laboratory enables the department to incorporate the computer into its undergraduate curriculum and thus enhances the ability of the students to conceptualize the essence of economic and empirical techniques. The award provides adequate capacity to absorb large classes such as Introductory Statistics, takes advantage of recent developments in object oriented languages, relational data bases, and integrated applications, as well as user friendly

environments developments that will help the student conceptualize the substance of the course material. Thirty one MacIntosh II's along with related peripheral equipment and software are provided. All students in the Introductory Statistics class can now take a computer laboratory course in statistics. In addition, by taking advantage of recent soft-

ware developments, the computer laboratory is used as a tool to enhance students' understanding of important economic and, especially, empirical concepts.

The award is being matched by an equal amount from the grantee.



# **IV. FY 1988 AWARDS: LOCATION BY STATE AND INSTITUTION DIRECTORATE FOR SCIENCE AND ENGINEERING EDUCATION INSTRUMENTATION AND LABORATORY IMPROVEMENT PROGRAM—FY88 AWARDS**

| <i>STATE<br/>INSTITUTION<br/>CITY, ZIP<br/>AWARD TITLE</i>                                                                                                                          | <i>PROJECT DIRECTOR<br/>PI DEPARTMENT</i>         | <i>DISCIPLINE<br/>CODE</i> | <i>AWARD<br/>AMOUNT</i> | <i>GRANT<br/>NUMBER</i> | <i>PAGE</i> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|----------------------------|-------------------------|-------------------------|-------------|
| <b>Alabama</b>                                                                                                                                                                      |                                                   |                            |                         |                         |             |
| Livingston University<br>Livingston 35470<br>Equipment for Improving Undergraduate Laboratories in Cellular Biology                                                                 | Richard D. Holland<br>Biology/                    | LIFE                       | \$15,000                | 8851894                 | 109         |
| Southern Union St Jr Col<br>Wadley 36276<br>Modernization of Instrument-Based Chemical Laboratory Education                                                                         | Janice B. Woodall<br>Chemistry                    | CHEM                       | \$21,022                | 8852299                 | 130         |
| Univ of South Alabama<br>Mobile 36688<br>Undergraduate Metallurgy Laboratory Improvement                                                                                            | Edmund Tsang<br>Mechanical Engineering            | ENGR                       | \$8,445                 | 8851334                 | 163         |
| Univ of South Alabama<br>Mobile 36688<br>Undergraduate Controls Laboratory                                                                                                          | Francis M. Donovan, Jr.<br>Mechanical Engineering | ENGR                       | \$34,992                | 8852321                 | 163         |
| Univ of South Alabama<br>Mobile 36688<br>Organic and Inorganic Compounds in Marine and Transitional Marine Environments: A Training<br>Experience for Under-graduate Science Majors | Wayne C. Isphording<br>Geology & Geography        | GEOL                       | \$46,000                | 8852952                 | 159         |
| <b>Arkansas</b>                                                                                                                                                                     |                                                   |                            |                         |                         |             |
| Arkansas Tech University<br>Russellville 72801<br>Sixteen Bit Digital Systems Laboratory                                                                                            | Archie G. Lambert<br>Engineering                  | ENGR                       | \$53,238                | 8851291                 | 163         |
| U Arkansas Little Rock<br>Little Rock 72204<br>Image Analysis and Microscopy for Undergraduate Biology                                                                              | Maurice G. Kleve<br>Biology                       | LIFE                       | \$43,384                | 8851981                 | 109         |
| U Arkansas Little Rock<br>Little Rock 72204<br>Modernization of Electronic Communication Laboratory                                                                                 | Ahand K. Ojha<br>Electronics Engr Technol         | ENGR                       | \$24,300                | 8852178                 | 163         |
| U Arkansas Monticello<br>Monticello 71655<br>Acquisition of Behavioral Science Laboratory Equipment                                                                                 | Jerome E. Young<br>Social & Behavioral Scs        | OTH                        | \$10,690                | 8851143                 | 192         |
| Univ of Central Arkansas<br>Conway 72032<br>Upgrading of Spectroscopic Techniques in the Undergraduate Curriculum                                                                   | Jerald M. Manion<br>Chemistry                     | CHEM                       | \$34,100                | 8851649                 | 130         |
| Henderson State University<br>Arkadelphia 71923<br>Computational Methods in the Undergraduate Physics Curriculum: An Integrated Approach                                            | Charles W. Leming<br>Physics                      | PHYS                       | \$7,500                 | 8851244                 | 184         |

| STATE<br>INSTITUTION<br>CITY, ZIP<br>AWARD TITLE                                                                                                                  | PROJECT DIRECTOR<br>PI DEPARTMENT           | DISCIPLINE<br>CODE | AWARD<br>AMOUNT | GRANT<br>NUMBER | PAGE |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------------|-----------------|-----------------|------|
| <b>Arizona</b>                                                                                                                                                    |                                             |                    |                 |                 |      |
| Mohave Community College<br>Kingman 86401<br>Undergraduate Biology and Chemistry Instrumentation for Freshman and Sophomore Laboratories                          | James A. Collier<br>Science                 | LIFE               | \$11,165        | 8853142         | 109  |
| <b>California</b>                                                                                                                                                 |                                             |                    |                 |                 |      |
| American River College<br>Sacramento 95825<br>Computer-directed Experiments for Freshman Chemistry Laboratories                                                   | Danny White<br>Chemistry                    | CHEM               | \$38,464        | 8851710         | 130  |
| Bakersfield Col<br>Bakersfield 93305<br>Improvement of Spectrophotometric Experiments in General and Organic Chemistry                                            | Ray M. Ward<br>Physical Science             | CHEM               | \$12,360        | 8852544         | 130  |
| Cal St Col San Bernardino<br>San Bernardino 92407<br>A Computer-Based Undergraduate Economics Curriculum                                                          | Ralph J. Charkins<br>Economics              | ECON               | \$36,970        | 8853029         | 192  |
| Cal St Poly Univ Pomona<br>Pomona 91768<br>Extended SEM Capabilities for Undergraduate Science Instruction Through Microcomputer Interfacing                      | David P. Campbell<br>Biological Scs         | OTH                | \$13,578        | 8852997         | 176  |
| Cal St Univ Fullerton<br>Fullerton 92631<br>Improvement of Instrumentation and Instructional Format in Physiological Psychology                                   | Richard A. McFarland<br>Psychology          | PSYC               | \$23,308        | 8851875         | 193  |
| Cal St Univ Fullerton<br>Fullerton 92631<br>Enhanced Earthquake Simulator                                                                                         | J.Dario Aristizabal<br>Civil Engr           | ENGR               | \$10,544        | 8852994         | 165  |
| Cal St Univ Fullerton<br>Fullerton 92631<br>Modern Electrophoresis and Immunochemistry Equipment for Undergraduate Laboratories                                   | Glenn M. Nagel<br>Chemistry & Biochemistry  | LIFE               | \$15,738        | 8853024         | 110  |
| Cal St Univ Long Beach<br>Long Beach 90840<br>Creating an Undergraduate Modern Optics Laboratory in Lasers and Laser Spectroscopy                                 | Michael S. Belsley<br>Physics               | PHYS               | \$25,887        | 8851582         | 184  |
| Cal St Univ Los Angeles<br>Los Angeles 90032<br>A Cogeneration Instrumentation Laboratory                                                                         | Phillip I. Gold<br>Mechanical Engineering   | ENGR               | \$11,317        | 8851329         | 165  |
| Cal St Univ Los Angeles<br>Los Angeles 90032<br>Universal Testing Machine for Materials Testing Laboratory                                                        | Anjan K. Bhaumik<br>Civil Engineering       | ENGR               | \$30,550        | 8851914         | 165  |
| Cal St Univ Los Angeles<br>Los Angeles 90032<br>Microcomputer Laboratory Facility to Upgrade the Teaching of Undergraduate Numerical Analysis and Related Courses | P. K. Subramanian<br>Mathe & Computer Sci   | MATH               | \$50,449        | 8852276         | 180  |
| Cal State Univ Fresno<br>Fresno 93740<br>Computer Aided Mapping                                                                                                   | Riadh Munjy<br>Civil & Surveying Engr       | ENGR               | \$51,000        | 8852157         | 164  |
| Cal State Univ Sacramento<br>Sacramento 95819<br>General Purpose Instrumentation Bus Laboratory                                                                   | James G. Simes<br>Electrical/Electronic Eng | ENGR               | \$50,000        | 8851141         | 165  |

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| Cal State Univ Sacramento<br>Sacramento 95819<br>Traffic Data Acquisition and Analysis Laboratory                                                                             | Joan Al-Kazily<br>Civil Engineering             | ENGR               | \$6,650         | 8851278         | 165  |
| Calif St Col Stanislaus<br>Turlock 95380<br>A Workstation Environment for Computer Science                                                                                    | Robert S. Cunningham<br>Computer Science        | COMP               | \$47,858        | 8852038         | 153  |
| Calif St U San Lu Obispo<br>San Luis Obispo 93407<br>Development of Pneumatic Automation Simulator                                                                            | K. N. Balasubramanian<br>Industrial Engineering | ENGR               | \$18,400        | 8851167         | 164  |
| Calif St U San Lu Obispo<br>San Luis Obispo 93407<br>Laboratory Equipment for an Undergraduate Biotechnology Program                                                          | Raul J. Cano<br>Biological Sciences             | LIFE               | \$48,850        | 8851335         | 110  |
| Calif St U San Lu Obispo<br>San Luis Obispo 93407<br>Environmental Experimentation Laboratory                                                                                 | D. Stafford Woolard<br>Architecture             | ENGR               | \$14,605        | 8851511         | 164  |
| Calif St U San Lu Obispo<br>San Luis Obispo 93407<br>An Integrated Natural Resources Management, Data Acquisition Analysis and Presentation System for Undergraduate Teaching | Norman H. Pillsbury<br>Natural Resources Mgmt   | LIFE               | \$50,000        | 8851523         | 110  |
| Calif St U San Lu Obispo<br>San Luis Obispo 93407<br>Advanced Electro-Optics Laboratory                                                                                       | Michael T. Wollman<br>Electronic/Elect Engr     | ENGR               | \$45,903        | 8852014         | 164  |
| Calif St U San Lu Obispo<br>San Luis Obispo 93407<br>Undergraduate Nondestructive Evaluation Facility                                                                         | Daniel W. Walsh<br>Metallurgical Engineering    | ENGR               | \$100,000       | 8853028         | 164  |
| Harvey Mudd Col<br>Claremont 91711<br>A Multi-Functional Laser Laboratory for Undergraduate Chemistry                                                                         | Gerald R. Van Hecke<br>Chemistry                | CHEM               | \$53,217        | 8851387         | 131  |
| Harvey Mudd Col<br>Claremont 91711<br>Undergraduate Laboratory on the Measurement of Temperature Dependent Properties of Materials.                                           | James C. Eckert<br>Physics                      | PHYS               | \$17,228        | 8852804         | 184  |
| Moorpark College<br>Moorpark 93021<br>Development of a Modern Physics Laboratory for Lower-Division Undergraduate Students                                                    | Clinton D. Harper<br>Physical Science           | PHYS               | \$19,024        | 8852053         | 184  |
| Occidental Col<br>Los Angeles 90041<br>GC-MS for Undergraduate Chemistry Laboratory                                                                                           | C. David West<br>Chemistry                      | CHEM               | \$31,228        | 8851689         | 131  |
| Pomona Col<br>Claremont 91711<br>Equipment for a Modern Undergraduate Laboratory in Plant Biology                                                                             | David W. Becker<br>Biology                      | LIFE               | \$36,471        | 8852604         | 110  |
| San Diego State Univ<br>San Diego 92182<br>Data Acquisition System for Wind-Tunnel Laboratories.                                                                              | Joseph Katz<br>Aerospace Eng/Eng Mechan         | ENGR               | \$47,615        | 8851535         | 165  |
| San Diego State Univ<br>San Diego 92182<br>A Twelve-Channel Seismograph for Field Work in Undergraduate Geophysics                                                            | Steven M. Day<br>Geological Scs                 | GEOL               | \$12,495        | 8852606         | 159  |



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| San Diego State Univ<br>San Diego 92182<br>Multiprocessor Architecture for Undergraduate Instruction                                  | Kasi Ananthanarayanan<br>Mathematical Sci       | COMP                             | \$27,707                      | 8852913                       | 153         |
| San Francisco State Univ<br>San Francisco 94132<br>Ultraviolet-Visible Spectrophotometers for Undergraduate Biochemistry Laboratories | Sergio Aragon<br>Chemistry & Biochemistry       | LIFE                             | \$39,327                      | 8851530                       | 111         |
| San Francisco State Univ<br>San Francisco 94132<br>Undergraduate Laboratory Instrumentation For Cell Biology                          | Jennifer Breckler<br>Biology                    | LIFE                             | \$47,200                      | 8852338                       | 111         |
| San Jose State University<br>San Jose 951920139<br>Computing Equipment for Realistic Modelling                                        | Leslie V. Foster<br>Computer Science            | MATH                             | \$48,182                      | 8852808                       | 180         |
| Sonoma State University<br>Rohnert Park 94928<br>Development of a Modern Undergraduate Mathematics Laboratory                         | Jean B. Chan<br>Mathematics                     | MATH                             | \$8,270                       | 8852470                       | 181         |
| Univ of San Francisco<br>San Francisco 94117<br>An Applied Mathematics Computing Laboratory                                           | Stanley D. Nel<br>Mathematics                   | MATH                             | \$42,897                      | 8852453                       | 181         |
| University of La Verne<br>La Verne 91750<br>Enhanced Instrumentation for Undergraduate Instruction in Environmental Chemistry         | Jay H. Jones<br>Chemistry & Biology             | OTH                              | \$17,041                      | 8853138                       | 176         |
| West Valley College<br>Saratoga 95070<br>Innovative Curriculum Applications in the Community College Mathematics Classroom            | Denny Burzynski<br>Mathematics                  | MATH                             | \$49,724                      | 8852707                       | 181         |
| Whittier College<br>Whittier 90608<br>Computer Based Instruction in Mathematics                                                       | Raymond Smith<br>Mathematics                    | MATH                             | \$13,813                      | 8851727                       | 181         |
| <b>Colorado</b>                                                                                                                       |                                                 |                                  |                               |                               |             |
| Metropolitan State Col<br>Denver 80204<br>Utilization of Gas Chromatograph/Mass Spectroscopy by Undergraduates                        | Jack D. Cummins<br>Chemistry                    | CHEM                             | \$36,373                      | 8851884                       | 131         |
| Otero Jr Col<br>La Junta 81050<br>Infrared Spectrophotometer for the Organic Chemistry Laboratory                                     | Bhal C. Barot<br>Science & Mathematics          | CHEM                             | \$5,000                       | 8852025                       | 132         |
| Univ of Southern Colorado<br>Pueblo 81001<br>A VLSI Digital Design Laboratory                                                         | David M. Perkins<br>Electronic Engr Technol     | ENGR                             | \$36,536                      | 8851248                       | 166         |
| <b>Connecticut</b>                                                                                                                    |                                                 |                                  |                               |                               |             |
| Fairfield University<br>Fairfield 06430<br>Gamma Ray Spectroscopy Equipment for Undergraduate Laboratories and Projects               | Jack W. Beal<br>Physics                         | PHYS                             | \$25,155                      | 8851344                       | 185         |
| Trinity College<br>Hartford 06106<br>An Undergraduate Computer Graphics Laboratory                                                    | August E. Sapega<br>Engr & Computer Sci         | COMP                             | \$22,010                      | 8851522                       | 154         |

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| Trinity College<br>Hartford 06106<br>Developmental Psychology Lab Improvements                                                                     | Dina L. Anselmi<br>Psychology             | PSYC               | \$5,442         | 8853242         | 193  |
| University of Hartford<br>West Hartford 06117<br>Equipment for an Investigation-Centered Undergraduate Cellular Biology Laboratory                 | Tracy L. Simpson<br>Biology               | LIFE               | \$56,564        | 8851605         | 112  |
| University of New Haven<br>West Haven 06516<br>Human Factors/Ergonomics Laboratory Enhancement                                                     | M. Ali Montazer<br>Industrial Engr        | ENGR               | \$21,746        | 8852376         | 177  |
| <b>Delaware</b>                                                                                                                                    |                                           |                    |                 |                 |      |
| Delaware State College<br>Dover 19901<br>Biology Laboratory Equipment to Support Undergraduates' Studies of the Health Problems in Black Americans | Dorene L. Petrosky<br>Biology             | LIFE               | \$21,360        | 8852969         | 112  |
| <b>Florida</b>                                                                                                                                     |                                           |                    |                 |                 |      |
| Eckerd College<br>Saint Petersburg 33733<br>Introduction of Fourier Transform Infrared Spectroscopy into the Chemistry Curriculum                  | Reggie L. Hudson<br>Chemistry             | CHEM               | \$10,000        | 8851650         | 132  |
| Jacksonville Univ<br>Jacksonville 32211<br>Electro-Optics Laboratory in Undergraduate Physics                                                      | James S. Browder<br>Physics               | PHYS               | \$17,747        | 8853090         | 185  |
| Miami Dade Cmty College<br>Miami 33176<br>Curriculum Development of Laboratory Courses through Atomic Absorption Spectrophotometry                 | Steven Radak<br>Chemistry & Earth Sci     | CHEM               | \$11,500        | 8852871         | 132  |
| Rollins College<br>Winter Park 32789<br>The Design of a Computer Algebra System to Effect a More Relevant Mathematics Curriculum                   | J. Douglas Child<br>Mathematical Sciences | MATH               | \$46,528        | 8852244         | 181  |
| Santa Fe Cmty College<br>Gainesville 32601<br>Improvement of the General Chemistry Curriculum Through Simulations and Modern Equipment             | Richard Schwartz<br>Chemistry             | CHEM               | \$26,411        | 8852354         | 132  |
| St Leo College<br>Saint Leo 33574<br>Improved Laboratory Instruction in Biology and Chemistry with Modern Ultraviolet-Visible Spectroscopy         | Robert H. Peterson<br>Chemistry           | OTH                | \$5,300         | 8851263         | 177  |
| Stetson Univ<br>Deland 32720<br>The Completion of a Microcomputer Network                                                                          | Gareth Williams<br>Mathe & Computer Sci   | MATH               | \$30,390        | 8851567         | 181  |
| Stetson Univ<br>Deland 32720<br>Computer Based Data Acquisition and Plotting Introductory Laboratory Experiments                                   | Thomas A. Lick<br>Physics                 | PHYS               | \$13,730        | 8851575         | 185  |
| Univ of West Fla<br>Pensacola 32514<br>Thermal Analysis Equipment for Undergraduate Laboratory Instruction in Chemistry                            | Grace Chiu<br>Chemistry                   | CHEM               | \$21,418        | 8851668         | 133  |

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| Univ of West Fla<br>Pensacola 32514<br>Enhancing Computerized Cartographic Instruction in an Undergraduate Geography Program                                | George H. Stopp, Jr.<br>Geography                         | GEOG                             | \$9,554                       | 8852720                       | 193         |
| <b>Georgia</b>                                                                                                                                              |                                                           |                                  |                               |                               |             |
| Agnes Scott Col<br>Decatur 30030<br>Improvements in Molecular Emission Experimentation at the Undergraduate Level                                           | Elizabeth Bottomley<br>Chemistry                          | CHEM                             | \$16,132                      | 8852283                       | 133         |
| Agnes Scott Col<br>Decatur 30030<br>Instructional Equipment to Improve Undergraduate Molecular and Cellular Biology Laboratories                            | Harry Wistrand<br>Biology                                 | LIFE                             | \$32,545                      | 8852671                       | 112         |
| Emanuel County Junior College<br>Swainsboro 30401<br>Chemistry                                                                                              | G. William Donaldson<br>Chemistry                         | CHEM                             | \$9,478                       | 8852380                       | 133         |
| Southern Col Technology<br>Marietta 30060<br>Automated Antenna Analysis Laboratory                                                                          | Preston A. White, III<br>Elect & Computer Engr Technology | ENGR                             | \$87,173                      | 8851403                       | 166         |
| Spelman College<br>Atlanta 30314<br>Instrumental Analysis and Data Analysis, an Honors Chemistry Course                                                     | Gladys S. Bayse<br>Chemistry                              | CHEM                             | \$8,149                       | 8853335                       | 133         |
| <b>Iowa</b>                                                                                                                                                 |                                                           |                                  |                               |                               |             |
| Cornell Col<br>Mount Vernon 52314<br>Integrating Graphics Workstation Technology into the Computer Science Curriculum                                       | James Freeman<br>Computer Sci                             | COMP                             | \$67,745                      | 8852519                       | 154         |
| Drake Univ<br>Des Moines 50311<br>Introduction of a Computer-Controlled Gas Chromatograph/Mass Spectrometer into an Updated Undergraduate Chemistry Program | Robert C. Larson<br>Chemistry                             | CHEM                             | \$29,150                      | 8852339                       | 134         |
| Grinnell Col<br>Grinnell 50112<br>Scanning Electron Microscopy for Undergraduate Student Research and Instruction in Biology                                | Lenore T. Durkee<br>Biology                               | LIFE                             | \$49,844                      | 8851261                       | 114         |
| Grinnell Col<br>Grinnell 50112<br>Computerization of Archaeological Mapping in Field School and Field Methods Classes                                       | Kathryn Kamp<br>Anthropology                              | ANTH                             | \$7,662                       | 8851417                       | 193         |
| Luther College<br>Decorah 52101<br>Enhanced Instruction in Spectrophotometry                                                                                | Walden L. Heino<br>Chemistry                              | CHEM                             | \$5,215                       | 8852154                       | 135         |
| Luther College<br>Decorah 52101<br>Implementing a New Integrated Cellular/Molecular Biology Laboratory for Undergraduates                                   | Marian M. Kaehler<br>Biology                              | LIFE                             | \$13,514                      | 8852615                       | 115         |
| Mount Mercy College<br>Cedar Rapids 52402<br>ADA in Undergraduate Computer Science                                                                          | Gloria L. Drapac<br>Mathematical Sciences                 | COMP                             | \$69,355                      | 8851377                       | 154         |
| Univ of Northern Iowa<br>Cedar Falls 50614<br>Improvement of Undergraduate Acoustics Laboratory Instruction                                                 | Roger J. Hanson<br>Physics                                | PHYS                             | \$10,180                      | 8852598                       | 186         |



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| Univ of Northern Iowa<br>Cedar Falls 50614<br>Electrochemical Equipment for the Instrumental Analysis Laboratory                                                              | Ching S. Woo<br>Chemistry                       | CHEM                             | \$11,922                      | 8853044                       | 135         |
| Univ of Northern Iowa<br>Cedar Falls 50614<br>Motion Analysis in Undergraduate Kinesiology                                                                                    | Nancy P. Hamilton<br>Sch of HPER                | OTH                              | \$12,174                      | 8853326                       | 177         |
| <b>Idaho</b>                                                                                                                                                                  |                                                 |                                  |                               |                               |             |
| Boise State University<br>Boise 83725<br>High Resolution Gamma Spectroscopy and Spectrum Analyzer for Undergraduate Laboratories, Projects and Undergraduate Student Research | Richard J. Reimann<br>Physics                   | PHYS                             | \$12,105                      | 8851891                       | 185         |
| Northwest Nazarene Col<br>Nampa 83651<br>Laboratory Modernization of Undergraduate Experimental Physics Laboratories                                                          | Francis A. Sharpton<br>Physics                  | PHYS                             | \$14,814                      | 8853288                       | 185         |
| <b>Illinois</b>                                                                                                                                                               |                                                 |                                  |                               |                               |             |
| Aurora University<br>Aurora 60506<br>Computerization of an Undergraduate Physiology Laboratory                                                                                | Peter J. Adragna<br>Biology                     | LIFE                             | \$5,960                       | 8852996                       | 113         |
| Bradley University<br>Peoria 61625<br>A Model Laboratory for Material Removal Processes                                                                                       | Iqbal Shareef<br>Manufacturing                  | ENGR                             | \$41,000                      | 8853061                       | 166         |
| Bradley University<br>Peoria 61625<br>Implementation of A Modern Data Acquisition System                                                                                      | D. Paul Mehta<br>Mechan Engr                    | ENGR                             | \$23,573                      | 8853102                       | 166         |
| Columbia College<br>Chicago 60605<br>Modernization of Undergraduate Biology Laboratory Programs for Communications Majors                                                     | Harvey V. Davis<br>Biology                      | LIFE                             | \$17,909                      | 8852558                       | 113         |
| Elgin Cmty Col<br>Elgin 60120<br>Equipment to Enhance the Undergraduate Chemistry Program at a Community College                                                              | Lavoie Banks<br>Chemistry                       | CHEM                             | \$39,964                      | 8852175                       | 133         |
| Ill E CC Olney Central<br>Olney 62450<br>"Instructional Equipment to Support Undergraduate Field Studies in Aquatic Microbiology"                                             | James Burnett<br>Biology                        | LIFE                             | \$8,070                       | 8852522                       | 113         |
| Knox College<br>Galesburg 61401<br>Revision of Junior Year Physical Chemistry Laboratory                                                                                      | Robert G. Kooser<br>Chemistry                   | CHEM                             | \$25,042                      | 8851423                       | 134         |
| Southn Ill U Edwardsville<br>Edwardsville 62026<br>Modern Instrumentation for Teaching Undergraduates to Measure Photosynthesis                                               | Marian Smith<br>Biological Sciences             | LIFE                             | \$9,710                       | 8851589                       | 114         |
| Southn Ill U Edwardsville<br>Edwardsville 62026<br>Parallel Computing in the Undergraduate Curriculum                                                                         | Marilynn L. Livingston<br>Computer Sci          | COMP                             | \$45,875                      | 8852165                       | 154         |
| Western Illinois Univ<br>Macomb 61455<br>Computerization of Introductory Physics Laboratories                                                                                 | Harold B. Hart<br>Physics                       | PHYS                             | \$13,254                      | 8851438                       | 185         |

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| <b>Indiana</b>                                                                                                                                                               |                                                   |                    |                 |                 |      |
| Earlham College<br>Richmond 47374<br>Instrumentation for Undergraduate Projects in Seismology                                                                                | Helen B. Hay<br>Geology                           | GEOL               | \$8,700         | 8851514         | 160  |
| Indiana Univ Southeast<br>New Albany 47150<br>A Computer Data Acquisition and Control Laboratory for Undergraduate Courses                                                   | Marshall P. Cady, Jr.<br>Div of Natural Sciences  | OTH                | \$21,210        | 8851189         | 177  |
| Marian College<br>Indianapolis 46222<br>Expansion of Electrochemistry in the Undergraduate Curriculum                                                                        | Edward J. Kelly<br>Chemistry                      | CHEM               | \$5,337         | 8852225         | 134  |
| Purdue U Ft Wayne<br>Fort Wayne 46805<br>Computer-Mediated Undergraduate Laboratories for Animal Physiology and Neurobiology                                                 | Richard S. Manalis<br>Biological Sciences         | LIFE               | \$28,701        | 8852393         | 114  |
| Rose-Hulman Inst of Tech<br>Terre Haute 47803<br>Modern Optical Instrumentation and Holography Laboratories for a New Undergraduate Program in Applied Optics                | Arthur B. Western<br>Physics                      | PHYS               | \$41,788        | 8851289         | 186  |
| Rose-Hulman Inst of Tech<br>Terre Haute 47803<br>A Symbolic, Numerical and Graphical Computations Lab to Support a Revised Curriculum in Calculus and Differential Equations | Robert J. Lopez<br>Mathematics                    | MATH               | \$100,000       | 8851339         | 182  |
| Rose-Hulman Inst of Tech<br>Terre Haute 47803<br>Development of a Flexible Microcomputer Laboratory for Teaching Digital Electronics and Microcomputers                      | Barry J. Farbrother<br>Electrical & Computer Engr | COMP               | \$85,000        | 8851364         | 154  |
| Rose-Hulman Inst of Tech<br>Terre Haute 47803<br>Polymer Engineering Laboratory Improvement Program                                                                          | Jerry A. Caskey<br>Chemical Engineering           | ENGR               | \$17,934        | 8851502         | 167  |
| Rose-Hulman Inst of Tech<br>Terre Haute 47803<br>Aeronautical Instruction Laboratory                                                                                         | Alan T. Roper<br>Mechanical Engr                  | ENGR               | \$41,500        | 8851543         | 167  |
| Rose-Hulman Inst of Tech<br>Terre Haute 47803<br>Integration of Bioseparations into the Chemical Engineering Curriculum                                                      | Ronald S. Artigue<br>Chemical Engineering         | ENGR               | \$24,718        | 8851780         | 167  |
| Rose-Hulman Inst of Tech<br>Terre Haute 47803<br>A Multipurpose Process Control Experiment Using Self-Tuning Controllers                                                     | Noel E. Moore<br>Chemical Engineering             | ENGR               | \$12,805        | 8851814         | 167  |
| St Mary's College<br>Notre Dame 46556<br>Equipment to Improve an Undergraduate Physiology Laboratory                                                                         | Nancy P. Nekvasil<br>Biology                      | LIFE               | \$10,230        | 8851769         | 114  |
| University of Evansville<br>Evansville 47702<br>Student Designed Projects in Measurements and Instrumentation                                                                | Philip M. Gerhart<br>Mechanical Engineering       | ENGR               | \$30,932        | 8851517         | 167  |
| Valparaiso Univ<br>Valparaiso 46383<br>Data Acquisition System for Mechanical Engineering Laboratories                                                                       | Gilbert M. Lehmann<br>Mechanical Engr             | ENGR               | \$8,860         | 8851636         | 168  |

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| Valparaiso Univ<br>Valparaiso 46383<br>An Integrated Design, Fabrication, and RF Testing Laboratory                                             | Merlyn C. Vocke<br>Elect & Computer Engr               | ENGR                       | \$44,386                | 8851690                 | 168         |
| Valparaiso Univ<br>Valparaiso 46383<br>Integration of Mathematical Software into Calculus Courses                                               | Joel P. Lehmann<br>Mathematics & Computer Sci          | MATH                       | \$20,696                | 8852197                 | 182         |
| <b>Kansas</b>                                                                                                                                   |                                                        |                            |                         |                         |             |
| Benedictine College<br>Atchison 66002<br>Integration of Modern Chromatographic Instrumentation into the Undergraduate Chemistry Curriculum      | Graham W. Ellis<br>Chemistry                           | CHEM                       | \$14,370                | 8851628                 | 135         |
| McPherson College<br>McPherson 67460<br>Bio-Analytical Instrumentation for Undergraduates in the Chemical and Biological Sciences               | Richard P. Zerger<br>Physical Sciences                 | OTH                        | \$13,950                | 8851437                 | 177         |
| Neosho County Cmty Jr Col<br>Chanute 66720<br>Atomic Absorption in a Cooperative Project with Local Industry                                    | Norma Steinman<br>Chemistry                            | CHEM                       | \$7,640                 | 8852226                 | 135         |
| <b>Kentucky</b>                                                                                                                                 |                                                        |                            |                         |                         |             |
| Hazard Community College<br>Hazard 41701<br>Integrating the Microcomputer into Introductory Physics Laboratories                                | Robert L. Sauer<br>Physics                             | PHYS                       | \$14,898                | 8852367                 | 186         |
| Lexington Community College<br>Lexington 40506<br>Microcomputer Laboratory for Calculus Instruction                                             | Lillie F. Crowley<br>Mathematics                       | MATH                       | \$28,983                | 8851488                 | 182         |
| Maysville Cmty Col<br>Maysville 41056<br>Micro-Computer Interfaced Equipment for Instructional Laboratories in a Community College              | Lloyd E. Story, Jr.<br>Div of Sci/Related Techno       | LIFE                       | \$5,887                 | 8851279                 | 115         |
| Western Kentucky Univ<br>Bowling Green 42101<br>Enhancement of a Flexible Manufacturing System                                                  | Kenneth Mussnug<br>Industrial & Engineering Technology | ENGR                       | \$23,978                | 8852159                 | 168         |
| Western Kentucky Univ<br>Bowling Green 42101<br>Acquisition of Spectrophotometric and Computer Interfacing Systems                              | Darwin B. Dahl<br>Chemistry                            | CHEM                       | \$15,669                | 8852664                 | 136         |
| <b>Louisiana</b>                                                                                                                                |                                                        |                            |                         |                         |             |
| Centenary College of La<br>Shreveport 71134<br>Computer-Assisted Data Acquisition in Undergraduate Physiology Laboratories                      | Beth E. Leuck<br>Biology                               | LIFE                       | \$6,753                 | 8851700                 | 115         |
| La St Univ in Shreveport<br>Shreveport 71115<br>Improved Chemistry Instruction with UV-Visible Spectrophotometry                                | James D. Goodrich<br>Chemistry                         | CHEM                       | \$14,242                | 8851427                 | 136         |
| McNeese State University<br>Lake Charles 70609<br>Upgrading of the Universal Testing Machine for Undergraduate Civil and Mechanical Engineering | Joseph M. Richardson<br>Civil/Mechanical Engr          | ENGR                       | \$43,400                | 8852893                 | 168         |



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| Southern U A&M Baton Rouge<br>Baton Rouge 70813<br>Robotics Laboratory Project                                                                                  | Amitava Jana<br>Mechanical Engr             | ENGR                       | \$23,882                | 8853122                 | 168         |
| <b>Massachusetts</b>                                                                                                                                            |                                             |                            |                         |                         |             |
| Col of the Holy Cross<br>Worcester 01610<br>Improvement of the Chemistry Curriculum Through FT-NMR Spectroscopy                                                 | Ronald M. Jarret<br>Chemistry               | CHEM                       | \$100,000               | 8852774                 | 137         |
| Merrimack College<br>North Andover 01845<br>An Integrated Four Year Spectroscopy Program                                                                        | Ronald M. Pike<br>Chemistry                 | CHEM                       | \$23,000                | 8851510                 | 137         |
| Merrimack College<br>North Andover 01845<br>NMR Instrumentation for Enhanced Undergraduate Instruction                                                          | Zvi Szafran<br>Chemistry                    | CHEM                       | \$34,937                | 8852203                 | 137         |
| Mt Holyoke Col<br>South Hadley 01075<br>Equipment to Modernize an Undergraduate Physiology Curriculum                                                           | Peter J. Gruber<br>Biological Sciences      | LIFE                       | \$37,053                | 8851401                 | 117         |
| Simmons College<br>Boston 02115<br>Enhancement of the Chemistry Curriculum by Replacement of an Outdated NMR Spectrometer with a Fourier Transform Spectrometer | James U. Piper<br>Chemistry                 | CHEM                       | \$59,049                | 8853324                 | 138         |
| Southeastern Mass Univ<br>North Dartmouth 02747<br>Scanning Electron Microscopy for Undergraduate Science and Engineering Education                             | Jefferson T. Turner<br>Biology              | OTH                        | \$66,422                | 8851158                 | 178         |
| Southeastern Mass Univ<br>North Dartmouth 02747<br>Equipment for Isolating Plasmid DNA and Cytochrome p450 in Undergraduate Laboratories                        | Robert N. Leamson<br>Biology                | LIFE                       | \$20,812                | 8851458                 | 117         |
| Wellesley Col<br>Wellesley 02181<br>Immunological Techniques in the Undergraduate Laboratory                                                                    | Barbara S. Beltz<br>Biological Sciences     | LIFE                       | \$40,742                | 8851888                 | 117         |
| Wellesley Col<br>Wellesley 02181<br>Purchase of Fluorescence Spectrometer in Undergraduate Education                                                            | William F. Coleman<br>Chemistry             | CHEM                       | \$24,300                | 8852245                 | 138         |
| Wheaton College<br>Norton 02766<br>Microcomputer-Controlled Instrumentation for an Undergraduate Physiology Laboratory                                          | Edmund Y. Tong<br>Biology                   | LIFE                       | \$17,370                | 8852416                 | 117         |
| Williams College<br>Williamstown 01267<br>Instrumentation for Precision Time Transfer in Undergraduate Physics and Astronomy Laboratories                       | Stuart B. Crampton<br>Physics and Astronomy | PHYS                       | \$32,690                | 8851881                 | 186         |
| Williams College<br>Williamstown 01267<br>Instrumentation for Mineral Separation and U-Pb Geochemistry Laboratories for Undergraduates                          | Paul Karabinos<br>Geology                   | GEOL                       | \$16,898                | 8852375                 | 160         |
| Williams College<br>Williamstown 01267<br>Robotics Lab for Non-Science Majors                                                                                   | Bryce A. Babcock<br>Physics & Astronomy     | COMP                       | \$25,869                | 8852643                 | 155         |

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| <b>Maryland</b>                                                                                                                                                                      |                                             |                            |                         |                         |             |
| Cecil Community College<br>North East 21901<br>Instrumentation for a Two-Year Chemistry Laboratory Technician Program                                                                | Darcy Williams<br>Chemistry                 | CHEM                       | \$32,127                | 8852474                 | 136         |
| Morgan State University<br>Baltimore 21239<br>Digital Circuits Laboratory                                                                                                            | Peter H. Anderson<br>Electrical Engineering | ENGR                       | \$15,551                | 8852176                 | 169         |
| St Mary's Col of Md<br>Saint Marys City 20686<br>Enhancing Instruction with NMR Spectrometry                                                                                         | Allan K. Hovland<br>Natural Sci/Mathematics | CHEM                       | \$34,837                | 8852439                 | 137         |
| Towson State Univ<br>Towson 21204<br>Biological Equipment for Teaching Instrumental Methods to Undergraduates                                                                        | Gerald D. Robinson<br>Biological Sciences   | LIFE                       | \$23,091                | 8851942                 | 116         |
| Towson State Univ<br>Towson 21204<br>Improvement of the Undergraduate Analytical Chemistry Curriculum through the Introduction of Atomic Absorption/Flame Emission Spectrophotometry | Joseph J. Topping<br>Chemistry              | CHEM                       | \$22,500                | 8852251                 | 137         |
| <b>Maine</b>                                                                                                                                                                         |                                             |                            |                         |                         |             |
| Bates College<br>Lewiston 04240<br>Computer Interfacing for Laboratory Data Acquisition and Analysis                                                                                 | James G. Boyles<br>Chemistry                | CHEM                       | \$10,576                | 8851648                 | 136         |
| Bates College<br>Lewiston 04240<br>Microcomputer-based Undergraduate Experiments in Laser Spectroscopy and Atomic Collision Phenomena                                                | John E. Smedley<br>Physics and Astronomy    | PHYS                       | \$13,515                | 8851997                 | 186         |
| Bates College<br>Lewiston 04240<br>Networking the Classroom and Microcomputer Laboratory to Enhance Undergraduate Training in Psychology                                             | Georgia N. Nigro<br>Psychology              | PSYC                       | \$44,287                | 8852194                 | 194         |
| Colby College<br>Waterville 04901<br>Fluorescence Microscopy for Undergraduate Teaching and Student Research                                                                         | Paul G. Greenwood<br>Biology                | LIFE                       | \$33,475                | 8852191                 | 116         |
| College of the Atlantic<br>Bar Harbor 04609<br>A Geographic Information System (GIS) for Teaching Environmental Science to Undergraduates                                            | John G. Anderson<br>Environmental Scs       | ENGR                       | \$6,385                 | 8852860                 | 169         |
| Univ of Maine Fort Kent<br>Fort Kent 04743<br>Undergraduate Laboratory Equipment for an Environmental Monitoring Technology Program                                                  | Ali Akbari<br>Chemistry                     | LIFE                       | \$48,750                | 8851421                 | 116         |
| <b>Michigan</b>                                                                                                                                                                      |                                             |                            |                         |                         |             |
| Adrian College<br>Adrian 49221<br>Equipment for an Undergraduate Program in Animal Behavior Communication and Ecology                                                                | Craig A. Weatherby<br>Biology               | LIFE                       | \$22,174                | 8851477                 | 118         |
| Albion College<br>Albion 49224<br>Course Improvement in Artificial Intelligence and Robotics                                                                                         | David W. Kammer<br>Physics                  | COMP                       | \$5,835                 | 8852986                 | 155         |

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| Alma College<br>Alma 48801<br>Computer Interfaced Experiments for General Chemistry and Physical Chemistry Laboratories       | James R. Hutchison<br>Chemistry                 | CHEM               | \$27,711        | 8852717         | 138  |
| Calvin College<br>Grand Rapids 49506<br>Integration of FT-NMR Spectroscopy into an Undergraduate Curriculum                   | Ronald L. Blankespoor<br>Chemistry              | CHEM               | \$65,600        | 8851202         | 138  |
| Central Mich Univ<br>Mount Pleasant 48859<br>Expanded Scanning Electron Microscopy Instruction for Undergraduates             | Daniel E. Wujek<br>Biology                      | OTH                | \$66,321        | 8851238         | 178  |
| Central Mich Univ<br>Mount Pleasant 48859<br>Operating Systems Laboratory Using Microcomputer Based Workstations              | Ishwar Rattan<br>Computer Science               | COMP               | \$14,310        | 8851239         | 155  |
| Central Mich Univ<br>Mount Pleasant 48859<br>NMR Spectroscopy in the Undergraduate Curriculum                                 | Bob A. Howell<br>Chemistry                      | CHEM               | \$34,850        | 8852049         | 139  |
| Central Mich Univ<br>Mount Pleasant 48859<br>Digital Image Processing Laboratory                                              | Sadali N. Jayaramamurthy<br>Computer Science    | COMP               | \$27,619        | 8852142         | 155  |
| Eastern Michigan Univ<br>Ypsilanti 48197<br>Computer Science Teacher Education Laboratory                                     | Mildred Lintner<br>Computer Science             | COMP               | \$37,461        | 8852658         | 155  |
| GMI Eng & Mgt Inst<br>Flint 48502<br>Computerized Data Acquisition for Human Factors Laboratory                               | David R. Clark<br>Industrial/Systems Engr       | ENGR               | \$13,037        | 8851791         | 159  |
| GMI Eng & Mgt Inst<br>Flint 48502<br>A High-Voltage Laboratory                                                                | Huseyin R. Hizioglu<br>Electrical/Computer Engr | ENGR               | \$100,000       | 8851806         | 169  |
| GMI Eng & Mgt Inst<br>Flint 48502<br>Computer Integrated Manufacturing Laboratory                                             | Maciej Zgorzelski<br>Mechanical Engr            | ENGR               | \$100,000       | 8852179         | 170  |
| Hope College<br>Holland 49423<br>Verification of the Uncertainty Principle in the Hope College Advanced Laboratory Course     | Ned C. Rouze<br>Physics                         | PHYS               | \$8,535         | 8852136         | 187  |
| Kalamazoo Col<br>Kalamazoo 49007<br>Computer Simulation Laboratory for Undergraduate Thermal Physics and Introductory Physics | Jan Tobochnik<br>Physics                        | PHYS               | \$13,750        | 8851210         | 187  |
| <b>Minnesota</b>                                                                                                              |                                                 |                    |                 |                 |      |
| Augsburg Col<br>Minneapolis 55454<br>A High Vacuum Laboratory for Undergraduate Instruction                                   | Brian J. Anderson<br>Physics                    | PHYS               | \$17,146        | 8852403         | 187  |
| Bemidji State University<br>Bemidji 56601<br>Improvement to the Undergraduate Laboratory Curriculum                           | Kirk P. Manfredi<br>Chemistry                   | CHEM               | \$30,850        | 8851455         | 139  |
| Carleton College<br>Northfield 55057<br>Neuroscience Laboratory (Psychology)                                                  | Jerry A. Eberhart<br>Psychology                 | OTH                | \$63,936        | 8851171         | 194  |

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| Gustavus Adolphus College<br>Saint Peter 56082<br>Artificial Intelligence Course Development Project                                                                     | Karl W. Knight<br>Mathematics/Computer Sci   | COMP                       | \$31,115                | 8852834                 | 155         |
| Hamline Univ<br>Saint Paul 55104<br>The Introduction of Fourier Transform Infrared Analysis into the Chemistry Curriculum                                                | Olaf A. Runquist<br>Chemistry                | CHEM                       | \$9,705                 | 8851429                 | 139         |
| Lakewood Community College<br>White Bear Lake 55110<br>Instrumentation and Laboratory Improvement in Undergraduate Chemistry                                             | Kenyon Latham<br>Chemistry                   | CHEM                       | \$6,670                 | 8853099                 | 139         |
| Macalester Col<br>Saint Paul 55105<br>Computer Laboratory for Cognitive Science Information                                                                              | Walter D. Mink<br>Psychology                 | PSYC                       | \$13,304                | 8851719                 | 194         |
| Macalester Col<br>Saint Paul 55105<br>An Undergraduate Computer Laboratory for the Biological Sciences                                                                   | Daniel J. Hornbach<br>Biology                | LIFE                       | \$41,586                | 8852273                 | 118         |
| Macalester Col<br>Saint Paul 55105<br>An Introductory Computer Science Laboratory                                                                                        | G. Michael Schneider<br>Mathe & Computer Sci | COMP                       | \$39,186                | 8853215                 | 156         |
| Mankato State University<br>Mankato 56001<br>An Atomic Absorption Spectrophotometer/Graphite Furnace foran Undergraduate Interdisciplinary Environmental Science Program | Bertha L. Proctor<br>Biology                 | LIFE                       | \$29,865                | 8851174                 | 118         |
| Mankato State University<br>Mankato 56001<br>Improvement of the Undergraduate Atmospheric Science Curriculum in Geography with Equipment for Real-Time Meteorology       | Cecil S. Keen<br>Geography                   | ATM                        | \$34,299                | 8852174                 | 160         |
| Mankato State University<br>Mankato 56001<br>Establishment of a Physical Anthropology Laboratory                                                                         | Paul F. Brown<br>Anthropology                | ANTH                       | \$11,456                | 8853333                 | 194         |
| Moorhead State Univ<br>Moorhead 56560<br>Instructional Computer Laboratory for Introduction to Statistics                                                                | Christine E. McLaren<br>Mathematics          | MATH                       | \$29,157                | 8851944                 | 182         |
| St Cloud State Univ<br>Saint Cloud 56301<br>Instrumentation to Develop an Undergraduate Immunology Program                                                               | Janet C. Woodard<br>Biological Scs           | LIFE                       | \$11,152                | 8852090                 | 119         |
| St John's University<br>Collegeville 56321<br>Integration of Gas Chromatography/Mass Spectrometry into the Undergraduate Chemistry Curriculum                            | Michael R. Ross<br>Chemistry                 | CHEM                       | \$48,250                | 8851849                 | 140         |
| St Mary's College<br>Winona 55987<br>Modernization of Optics Experiments in Advanced Undergraduate Labs                                                                  | Donald R. Morgan<br>Physics                  | PHYS                       | \$8,300                 | 8851415                 | 187         |
| St Mary's College<br>Winona 55987<br>Standard and Fluorescence Cytophotometry Equipment for the Undergraduate Curriculum and Student Research                            | Richard V. Kowles<br>Biology                 | LIFE                       | \$15,529                | 8852046                 | 119         |



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| St Olaf College<br>Northfield 55057<br>Development of Interactive Laboratory-Classroom in Psychology                                              | James F. Dickson<br>Psychology                  | PSYC                             | \$18,106                      | 8851795                       | 195         |
| St Olaf College<br>Northfield 55057<br>Integration of Computer Tools into Classroom Mathematics Instruction                                       | Alan Magnuson<br>Mathematics                    | MATH                             | \$14,680                      | 8851796                       | 182         |
| Univ of Minn at Duluth<br>Duluth 55812<br>Equipment for Signal Processing/Communication Laboratories                                              | Ali R. Delavari<br>Computer Engineering         | COMP                             | \$87,865                      | 8851460                       | 156         |
| Univ of Minn at Duluth<br>Duluth 55812<br>Teaching Programmable Instrumentation Control                                                           | Donald R. Zrudsky<br>Computer Engineering       | ENGR                             | \$37,707                      | 8851816                       | 170         |
| Univ of Minn at Duluth<br>Duluth 55812<br>Fourier Transform Infrared Spectrometers for Undergraduate Instructional Laboratories                   | Deborah E. Samkoff<br>Chemistry                 | CHEM                             | \$17,803                      | 8852907                       | 140         |
| <b>Missouri</b>                                                                                                                                   |                                                 |                                  |                               |                               |             |
| Northeast Mo State Univ<br>Kirksville 63501<br>Laboratory Improvement for Cell Biology                                                            | Gary D. Sells<br>Biology                        | LIFE                             | \$62,000                      | 8851433                       | 119         |
| Rockhurst Col<br>Kansas City 64110<br>Integration of NMR Spectroscopy Theory and Laboratory Applications in Undergraduate Chemistry Curriculum    | Don E. Gibbs<br>Chemistry                       | CHEM                             | \$25,850                      | 8852343                       | 140         |
| Southwest Mo State Univ<br>Springfield 65804<br>The Social Science Research Laboratory                                                            | David J. Hartmann<br>Sociology/Anthrop/SWK      | SOC                              | \$12,576                      | 8852039                       | 195         |
| Southwest Mo State Univ<br>Springfield 65804<br>Drafting Fundamentals—Micro-CAD Laboratory                                                        | Scott Carpenter<br>Industrial Technology        | ENGR                             | \$72,422                      | 8852040                       | 170         |
| Southwest Mo State Univ<br>Springfield 65804<br>A Tabletop Ultracentrifuge for Teaching Undergraduate Cellular & Molecular Biology                | Christopher C. Field<br>Biomedical Sciences     | LIFE                             | \$14,827                      | 8852048                       | 120         |
| St L CC Adm Ctr Meramec<br>Kirkwood 63122<br>Introduction of NMR to Undergraduate Laboratories                                                    | Leonora G. Rueppel<br>Chemistry                 | CHEM                             | \$26,350                      | 8852082                       | 140         |
| Stephens Col<br>Columbia 65215<br>Instrumentation to Support Student Research in Molecular Biology by Undergraduate Women                         | James D. Hoerter<br>Natural Sciences            | LIFE                             | \$15,000                      | 8851225                       | 120         |
| <b>Mississippi</b>                                                                                                                                |                                                 |                                  |                               |                               |             |
| Jackson State University<br>Jackson 39217<br>Microcomputer Assistance to Upgrade Physiological Psychology, Experimental Psychology and Statistics | Stephen F. Bollinger<br>Psychology              | PSYC                             | \$7,130                       | 8852929                       | 195         |
| Mississippi College<br>Clinton 39058<br>Fourier-Transform Infrared Spectroscopy for a Modern Chemistry Curriculum                                 | Edward J. Valente<br>Chemistry                  | CHEM                             | \$10,325                      | 8851694                       | 140         |

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| Tougaloo College<br>Tougaloo 39174<br>Computer Science Curriculum Improvement                                                          | John B. Garner<br>Computer Science              | COMP                             | \$70,739                      | 8852861                       | 156         |
| <b>Montana</b>                                                                                                                         |                                                 |                                  |                               |                               |             |
| Dull Knife Memorial College<br>Lame Deer 59043<br>Technical Graphics Laboratory                                                        | S. Valentine<br>Interdisciplinary               | OTH                              | \$45,974                      | 8853146                       | 178         |
| Mt Col Mineral Sci & Tech<br>Butte 59701<br>Surveying Laboratory Enhancement                                                           | Thomas E. Finch<br>Mining Engineering           | ENGR                             | \$48,330                      | 8851803                       | 170         |
| Mt Col Mineral Sci & Tech<br>Butte 59701<br>Field Equipment for Undergraduate Hydrogeological Program                                  | John L. Sonderegger<br>Geological Engineering   | GEOL                             | \$41,610                      | 8852350                       | 160         |
| Rocky Mountain Col<br>Billings 59102<br>Equipment to Improve the Undergraduate Biochemistry Laboratory Program                         | Lonnie J. Guralnick<br>Biology                  | LIFE                             | \$15,500                      | 8851150                       | 120         |
| <b>North Carolina</b>                                                                                                                  |                                                 |                                  |                               |                               |             |
| Appalachian State Univ<br>Boone 28608<br>Computer Operating Systems Instructional Improvement Project                                  | Edward G. Pekarek<br>Mathematical Scs           | COMP                             | \$16,175                      | 8852020                       | 157         |
| Appalachian State Univ<br>Boone 28608<br>Thin Film Deposition and Etching Facility for Undergraduate Physics Students                  | Milan C. Buncick<br>Physics & Astronomy         | PHYS                             | \$22,398                      | 8852985                       | 188         |
| Appalachian State Univ<br>Boone 28608<br>A Modern Technology Telescope for Undergraduate Student Projects and Research                 | Daniel B. Caton<br>Physics & Astronomy          | AST                              | \$100,000                     | 8852993                       | 188         |
| Appalachian State Univ<br>Boone 28608<br>Mathematical Sciences Microcomputer Teaching Laboratory                                       | William C. Bauldry<br>Mathematical Scs          | MATH                             | \$45,680                      | 8853085                       | 183         |
| Appalachian State Univ<br>Boone 28608<br>Undergraduate Investigative Laboratories for Understanding Physiological Systems              | Mary U. Connell<br>Biology                      | LIFE                             | \$20,724                      | 8853233                       | 122         |
| Belmont Abbey Col<br>Belmont 28012<br>Equipment for an Undergraduate Laboratory Program in Cellular Biology                            | Michael J. McLeod<br>Biology                    | LIFE                             | \$11,650                      | 8851571                       | 122         |
| Elizabeth City State Univ<br>Elizabeth City 27909<br>Dual Polarizing Microscopy for Undergraduate Teaching Program                     | R. P. Sinha<br>Geosciences                      | GEOL                             | \$5,551                       | 8851190                       | 161         |
| Pembroke State University<br>Pembroke 28372<br>Contemporary Data Acquisition Methods in Science Laboratories                           | Jose J. D'Arruda<br>Physical Science            | PHYS                             | \$14,665                      | 8852017                       | 188         |
| Roanoke-Chowan Tech Inst<br>Ahoskie 27910<br>Computer-Interfaced Instrumentation for an Undergraduate Environmental Science Laboratory | David W. Hollar, Jr.<br>Science                 | LIFE                             | \$5,749                       | 8852752                       | 123         |

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| U of N C at Charlotte<br>Charlotte 28223<br>Raman Spectroscopy for an Undergraduate Solid State Physics Laboratory                                          | Robert G. Aitken<br>Physics                 | PHYS                       | \$10,265                | 8852056                 | 189         |
| U of N C at Charlotte<br>Charlotte 28223<br>Comprehensive Geotechnical Engineering Laboratory                                                               | R. Janardhanam<br>Civil Engineering         | ENGR                       | \$40,225                | 8852316                 | 172         |
| U of N C at Charlotte<br>Charlotte 28223<br>Microprocessor Interfacing for Undergraduates in Mechanical Engineering                                         | Edgar G. Munday<br>Mechanical Engr/Engr Sci | ENGR                       | \$6,750                 | 8852841                 | 172         |
| Univ of N C at Asheville<br>Asheville 28814<br>Modernization of Experiments and Expansion of Undergraduate Instrument Techniques with an FT-IR Spectrometer | Charles G. James<br>Chemistry               | CHEM                       | \$29,576                | 8852645                 | 145         |
| Western Carolina Univ<br>Cullowhee 28723<br>Geographic Information System Laboratory for Undergraduate Instruction                                          | Lawrence G. Kolenbrander<br>Anthropology    | OTH                        | \$38,367                | 8851879                 | 195         |
| <b>Nebraska</b>                                                                                                                                             |                                             |                            |                         |                         |             |
| Doane College<br>Crete 68333<br>Modernization of the Spectrophotometric Capabilities of Doane College                                                       | David H. Smith<br>Chemistry                 | CHEM                       | \$5,880                 | 8851378                 | 141         |
| Kearney State Col<br>Kearney 68849<br>Computer Laboratory in Human Experimental Psychology                                                                  | William J. Wozniak<br>Psychology            | PSYC                       | \$11,312                | 8852068                 | 195         |
| Univ of Nebraska at Omaha<br>Omaha 68182<br>NMR Across the Curriculum                                                                                       | James P. Hagen<br>Chemistry                 | CHEM                       | \$62,365                | 8851356                 | 141         |
| <b>New Hampshire</b>                                                                                                                                        |                                             |                            |                         |                         |             |
| Rivier Col<br>Nashua 03060<br>Incorporation of Fourier Transform Infrared Spectroscopy into the Undergraduate Chemistry Curriculum                          | William D. Totherow<br>Chemistry            | CHEM                       | \$23,584                | 8851931                 | 141         |
| Saint Anselm College<br>Manchester 03102<br>Instrumentation for Instruction and Research in Psychophysiology                                                | Lowell A. Roberts<br>Psychology             | PSYC                       | \$18,502                | 8852967                 | 196         |
| <b>New Jersey</b>                                                                                                                                           |                                             |                            |                         |                         |             |
| Bloomfield Col<br>Bloomfield 07003<br>Laboratory for Applied Scientific Computing                                                                           | Alice A. Sayler<br>Natural Sci & Math       | ENGR                       | \$18,213                | 8852475                 | 170         |
| Cumberland County Col<br>Vineland 08360<br>Plastics Processing Laboratory for Undergraduate Instruction                                                     | Kamal Sinha<br>Plastics Technology          | CHEM                       | \$97,095                | 8852285                 | 142         |

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| <b>New York</b>                                                                                                                                                                                          |                                                   |                    |                 |                 |      |
| CUNY Boro of Man. Cmty Coll<br>New York, NY 10007<br>Project MICRO-CALC: Microcomputer for Classroom and Learning Center Calculus                                                                        | Patricia R. Wilkinson<br>Mathematics              | MATH               | \$37,421        | 8851194         | 183  |
| CUNY Bronx Cmty Coll<br>New York 10453<br>Microcomputer Based Introductory Laboratories Using Titrations                                                                                                 | James A. Fahey<br>Chemistry                       | CHEM               | \$11,013        | 8852184         | 142  |
| CUNY H L Lehman College<br>New York 10468<br>Implementation of GC-Mass Spectrometry for Undergraduates in Forensic Science and Organic Chemistry                                                         | Reuben L. Baumgarten<br>Chemistry/Anthropology    | OTH                | \$69,000        | 8853006         | 143  |
| CUNY John Jay College<br>New York 10019<br>Using Pyrolysis-GC-MS to Enhance Student's Knowledge of Modern Instrumental Microanalytical Techniques and Methods of Science Research                        | Lawrence Kobilinsky<br>Science                    | CHEM               | \$35,300        | 8851684         | 143  |
| Colgate University<br>Hamilton 13346<br>An Undergraduate AI Laboratory                                                                                                                                   | Thomas J. Myers<br>Computer Science               | COMP               | \$24,027        | 8851192         | 156  |
| Colgate University<br>Hamilton 13346<br>Computers for Undergraduate Ecology and Population Biology Laboratories                                                                                          | Robert M. Arnold<br>Biology                       | LIFE               | \$18,321        | 8851474         | 120  |
| Colgate University<br>Hamilton 13346<br>Incorporation of Gas Chromatography/Mass Spectrometry into Undergraduate Instruction                                                                             | David K. Lewis<br>Chemistry                       | CHEM               | \$23,300        | 8852990         | 142  |
| Cooper Union<br>New York 10003<br>Comprehensive Introduction of Computer Aided Engineering, Computer Aided Design and Manufacturing Facilities to the Undergraduate Curriculum in Mechanical Engineering | Devdas Shetty<br>Mechanical Engr                  | ENGR               | \$60,213        | 8852135         | 171  |
| Elmira Col<br>Elmira 14901<br>Establishment of Subcellular Fractionation Capabilities for Undergraduate Coursework and Student Research                                                                  | Pierre-Yves Bouthyette<br>Math & Natural Sciences | LIFE               | \$20,781        | 8851864         | 121  |
| Hartwick Col<br>Oneonta 13820<br>Integration of Instrumental Methods into an Undergraduate Curriculum. Instrumental Analysis: It Isn't Just for Juniors Anymore                                          | Richard C. Reed<br>Chemistry                      | CHEM               | \$39,500        | 8851622         | 143  |
| Nazareth Col of Rochester<br>Rochester 14610<br>Computerized Image Analysis of Biological Data in Undergraduate Instruction                                                                              | Matthew J. Temple<br>Biology                      | LIFE               | \$10,988        | 8853194         | 121  |
| Rochester Inst of Tech<br>Rochester 14623<br>Digital Document Processing Laboratory System                                                                                                               | Ronald G. Matteson<br>Computer Engineering        | COMP               | \$38,465        | 8851810         | 157  |
| Rochester Inst of Tech<br>Rochester 14623<br>Development of an Undergraduate Systems and Control Laboratory                                                                                              | Mark Kempfski<br>Mechanical Engr                  | ENGR               | \$29,499        | 8852420         | 171  |



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| Rochester Inst of Tech<br>Rochester 14623<br>Thermal Design of Integrated Circuits                                                                             | Lynn Fuller<br>Microelectronic Engr                       | ENGR               | \$41,076        | 8852823         | 171  |
| Russell Sage C JC Albany<br>Albany 12208<br>Acquisition of a Recording Infrared Spectrophotometer for Organic Chemistry                                        | Daniel Lewicki<br>Math/Science Div                        | CHEM               | \$5,611         | 8852971         | 143  |
| Skidmore College<br>Saratoga Springs 12866<br>Instrumentation to Improve Undergraduate Laboratory and Field Studies in Organismic Biology                      | Sherilyn G. F. Smith<br>Biology                           | LIFE               | \$7,704         | 8852897         | 121  |
| SUNY Col at Plattsburgh<br>Plattsburgh 12901<br>Distributed Processing and Computer Control                                                                    | John W. McCormick<br>Computer Sci                         | COMP               | \$41,711        | 8852686         | 157  |
| SUNY Col at Plattsburgh<br>Plattsburgh 12901<br>Automation and Modernization of an X-Ray Diffractometer for Undergraduate Environmental Geology and Hydrology  | James F. Olmsted<br>Ctr for Earth & Environmental Science | GEOL               | \$13,872        | 8853026         | 160  |
| SUNY College at Fredonia<br>Fredonia 14063<br>Fourier Transform Infrared Spectroscopy for Undergraduates                                                       | Timothy Eckert<br>Chemistry                               | CHEM               | \$18,904        | 8851903         | 143  |
| SUNY Erie Cmty Col North<br>Williamsville 14221<br>Acquisition of CAD Equipment                                                                                | Joseph R. Cristina, Jr.<br>Civil Engr Technology          | ENGR               | \$50,208        | 8852002         | 171  |
| SUNY Fashion Inst of Tech<br>New York 10001<br>Color and Light: Education in Applied Physics at the Fashion Institute of Technology                            | Evelyn Stephens<br>Science & Math                         | PHYS               | \$22,125        | 8852778         | 188  |
| SUNY Ulster Cty Cmty Col<br>Stone Ridge 12484<br>Introduction of Inductively Coupled Plasma Technology to a Community College Water Quality Monitoring Program | Theodore J. Skaar<br>Geology                              | GEOL               | \$32,500        | 8851930         | 160  |
| SUNY Ulster Cty Cmty Col<br>Stone Ridge 12484<br>Computerization of the General Chemistry Laboratory at Ulster County Community College                        | Dennis P. Swauger<br>Physical Sciences                    | CHEM               | \$33,639        | 8851801         | 143  |
| Siena College<br>Loudonville 12211<br>Introduction of Molecular Genetics Techniques into the Undergraduate Curriculum                                          | Lise D. Wilson<br>Biology                                 | LIFE               | \$19,518        | 8852776         | 121  |
| The Cooper Union Sch Eng<br>New York 10003<br>Environmental Engineering Laboratory                                                                             | Constantine Yapijakis<br>Civil Engr                       | ENGR               | \$35,325        | 8852336         | 171  |
| Utica Col of Syracuse U<br>Utica 13502<br>FTIR Spectroscopy in Undergraduate Laboratories                                                                      | William F. Pfeiffer<br>Chemistry                          | CHEM               | \$25,639        | 8851770         | 143  |
| Vassar College<br>Poughkeepsie 12601<br>Equipment for Teaching and Student Research in Plant Ecology and Evolutionary Biology                                  | Mark A. Schlessman<br>Biology                             | LIFE               | \$48,900        | 8852608         | 122  |
| Wells College<br>Aurora 13026<br>Inorganic Chemistry for Undergraduates: Necessary Instruments                                                                 | Christopher T. Bailey<br>Chemistry                        | CHEM               | \$14,640        | 8851384         | 144  |

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| <b>Ohio</b>                                                                                                                                            |                                                 |                                  |                               |                               |             |
| Col of Wooster<br>Wooster 44691<br>A Laser Optics Laboratory for Undergraduate Projects                                                                | Shila Venkataraman<br>Physics                   | PHYS                             | \$20,835                      | 8851515                       | 189         |
| Marietta Col<br>Marietta 45750<br>Fourier-Transform Infrared Spectroscopy in Undergraduate Chemistry                                                   | Hans-Georg Gilde<br>Chemistry                   | CHEM                             | \$11,537                      | 8851498                       | 145         |
| Marietta Col<br>Marietta 45750<br>Using Sensors and Microcomputers to Simplify the Learning of Concepts in the Introductory Physics Laboratory         | R. Lester Anderson<br>Physics                   | PHYS                             | \$30,500                      | 8852995                       | 189         |
| Muskingum Col<br>New Concord 43762<br>Fluorescence Microscope with Computer Linkage to Support Undergraduate Studies in Physiology, Genetics & Anatomy | David L. Quinn<br>Biology                       | LIFE                             | \$14,421                      | 8853032                       | 123         |
| Notre Dame Col<br>Cleveland 44121<br>Improved Optical Microscopy to Enhance Undergraduate Biology Laboratories                                         | Susan K. Hill<br>Biology                        | LIFE                             | \$11,126                      | 8853308                       | 123         |
| Oberlin Col<br>Oberlin 44074<br>Computer Graphics for Majors and Non-Majors                                                                            | Robert Geitz<br>Computer Science Program        | COMP                             | \$37,337                      | 8851262                       | 157         |
| Ohio Wesleyan Univ<br>Delaware 43015<br>An HPLC for Improved Instruction in Chemistry                                                                  | Theodore L. Miller<br>Chemistry                 | CHEM                             | \$17,547                      | 8852693                       | 145         |
| Youngstown St Univ<br>Youngstown 44555<br>Instruments to Improve the Undergraduate Core Curriculum in Microbiology                                     | Jeffrey J. Sich<br>Biological Sciences          | LIFE                             | \$26,799                      | 8851165                       | 124         |
| <b>Oklahoma</b>                                                                                                                                        |                                                 |                                  |                               |                               |             |
| Cameron University<br>Lawton 73505<br>Engineering Technology Instrumentation Laboratory Improvement                                                    | Don Phillips<br>Technology                      | ENGR                             | \$50,000                      | 8852254                       | 172         |
| Connors State College<br>Warner 74469<br>Upgrading Mathematical Skills Through Computer Assisted Instruction                                           | Betty L. Acord<br>Math-Science/Computer-Science | MATH                             | \$13,609                      | 8852310                       | 183         |
| Northern Oklahoma A & M<br>Miami 74354<br>Computers in the Undergraduate Physics Laboratory                                                            | Daniel E. Beeker<br>Physics                     | PHYS                             | \$20,872                      | 8852433                       | 189         |
| <b>Oregon</b>                                                                                                                                          |                                                 |                                  |                               |                               |             |
| Lewis and Clark Col<br>Portland 97219<br>Solid State Laboratory for Advanced Undergraduate Physics Students                                            | John C. Abele<br>Physics                        | PHYS                             | \$26,927                      | 8851283                       | 189         |
| Lewis and Clark Col<br>Portland 97219<br>Acquisition of a High-field FT NMR Spectrometer for Undergraduate Research and Instruction                    | James A. Duncan<br>Chemistry                    | CHEM                             | \$62,700                      | 8851627                       | 146         |

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| Oregon Inst of Technology<br>Klamath Falls 97601<br>Analog Circuit Instruction Improvement                                                                                 | John M. Yarbrough<br>Electronics Engr Technol    | ENGR                       | \$37,816                | 8851227                 | 172         |
| Pacific Univ<br>Forest Grove 97116<br>Integrated High Performance Liquid Chromatograph for Undergraduate Instruction                                                       | Richard V. Whiteley<br>Chemistry                 | CHEM                       | \$14,951                | 8851866                 | 146         |
| Reed Col<br>Portland 97202<br>An FTIR Spectroscopy Laboratory for Teaching and Undergraduate Research                                                                      | J. W. Powell<br>Physics                          | PHYS                       | \$93,831                | 8851509                 | 190         |
| Reed Col<br>Portland 97202<br>Acquisition of a High Field NMR Spectrometer, and its Integration into the Chemistry Curriculum                                              | John E. Hancock<br>Chemistry                     | CHEM                       | \$100,000               | 8852500                 | 146         |
| Reed Col<br>Portland 97202<br>A Core Facility for Teaching Undergraduate Cellular and Molecular Biology                                                                    | Maryanne McClellan<br>Biology                    | LIFE                       | \$93,560                | 8852739                 | 124         |
| <b>Pennsylvania</b>                                                                                                                                                        |                                                  |                            |                         |                         |             |
| Allegheny Col<br>Meadville 16335<br>Water Analysis Laboratory for Undergraduate Instruction                                                                                | Samuel S. Harrison<br>Environmental Science      | OTH                        | \$11,900                | 8851340                 | 196         |
| Bucknell Univ<br>Lewisburg 17837<br>Real Time Signal Processing Laboratory                                                                                                 | Mohamed A. El-Sharkawy<br>Electrical Engineering | ENGR                       | \$12,659                | 8851208                 | 172         |
| Bucknell Univ<br>Lewisburg 17837<br>A Parallel Computation Laboratory                                                                                                      | Daniel C. Hyde<br>Computer Science               | COMP                       | \$63,354                | 8853185                 | 157         |
| Bucknell Univ<br>Lewisburg 17837<br>Computer Graphics Animation                                                                                                            | Patricia A. Wenner<br>Computer Sci               | COMP                       | \$55,000                | 8853222                 | 158         |
| Cal Univ of Pennsylvania<br>California 15419<br>A Scanning Electron Microscope to Improve the Undergraduate Biology Curriculum                                             | Foster E. Billheimer<br>Biological/Environ Scs   | LIFE                       | \$41,444                | 8851166                 | 124         |
| Carlow College<br>Pittsburgh 15213<br>Equipment for Improving Undergraduate Instruction in Physiology                                                                      | Charlotte A. Zalewsky<br>Biology                 | LIFE                       | \$8,101                 | 8851936                 | 124         |
| Cedar Crest Col<br>Allentown 18104<br>Undergraduate Research Groups—A Model Method for Teaching Genetic Engineering Technology                                             | Arthur R. Ayers<br>Biology                       | LIFE                       | \$11,330                | 8852085                 | 125         |
| Chestnut Hill Col<br>Philadelphia 19118<br>Introduction of Fourier Transform Infrared Spectroscopy into the Undergraduate Chemistry Curriculum                             | Grace A. Banks<br>Chemistry                      | CHEM                       | \$10,787                | 8852679                 | 147         |
| Franklin & Marshall Col<br>Lancaster 17604<br>Applications Development for an Ion Trap Detector at an Undergraduate Level                                                  | Kenneth R. Hess<br>Chemistry                     | CHEM                       | \$32,773                | 8851677                 | 147         |
| Indiana Univ of Penn<br>Indiana 15705<br>CAMAC (Computer Automated Measurement and Control) Based Data Acquisition System for the Undergraduate Nuclear Physics Laboratory | Vythilingam Wijekumar<br>Physics                 | PHYS                       | \$10,399                | 8851861                 | 190         |

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| Harrisburg Area Comm Col<br>Harrisburg 17110<br>CAD/CAM Manufacturing and Automated Processing Laboratory                                                                                            | Richard Ciocci<br>Mechanical Engr Technol     | ENGR                       | \$71,056                | 8852855                 | 173         |
| Lafayette Col<br>Easton 18042<br>Incorporation of FT-NMR Spectroscopy into the Undergraduate Physical Science Curriculum                                                                             | Thomas S. Lillie<br>Chemistry/Physics         | OTH                        | \$86,150                | 8851625                 | 178         |
| Lebanon Valley Col<br>Annville 17003<br>The Introduction of an Atomic Absorption Spectrophotometer into the Chemistry Curriculum to Strengthen Laboratory Instruction                                | Richard D. Cornelius<br>Chemistry             | CHEM                       | \$16,566                | 8851260                 | 147         |
| Lebanon Valley Col<br>Annville 17003<br>Improvement of the Undergraduate Comparative Histology Laboratory Experience                                                                                 | Allan F. Wolfe<br>Biology                     | LIFE                       | \$21,462                | 8853192                 | 125         |
| Lock Haven Univ of Penn<br>Lock Haven 17745<br>Learning Chemistry as a Process: Chemical Kinetics                                                                                                    | Ellen P. O'Hara-Mays<br>Chemistry/Phys/Geosci | CHEM                       | \$11,389                | 8852123                 | 147         |
| Millersville Univ of Penn<br>Millersville 17551<br>Magnetic Tape Module for Processing and Archiving Satellite Image Data for Undergraduate Laboratories Using Earth Resources Data Satellite Images | Yin S. Soong<br>Earth Sciences                | GEOL                       | \$6,390                 | 8851450                 | 161         |
| St Vincent Col<br>Latrobe 15650<br>Computer Interfacing with Radio and Optical Astronomical Telescopes                                                                                               | Gordon C. McIntosh<br>Physics                 | AST                        | \$5,361                 | 8852767                 | 190         |
| Susquehanna Univ<br>Selinsgrove 17870<br>An Electromagnetic Conductivity Meter for Undergraduate Laboratories in Groundwater Resource and Contamination Evaluation                                   | Frank W. Fletcher<br>Geological/Environ Sci   | GEOL                       | \$6,850                 | 8851365                 | 161         |
| Susquehanna Univ<br>Selinsgrove 17870<br>Fiber Optics and a Sophisticated Spectrometer in an Undergraduate Physics Program                                                                           | Richard W. Kozlowski<br>Physics               | PHYS                       | \$7,123                 | 8851978                 | 190         |
| Swarthmore Col<br>Swarthmore 19081<br>Enhanced Engineering Materials-Evaluation Laboratory                                                                                                           | Faruq M. Siddiqui<br>Engineering              | ENGR                       | \$14,132                | 8851669                 | 173         |
| Swarthmore Col<br>Swarthmore 19081<br>Laser Atomic/Molecular Spectroscopy Laboratory for Undergraduate Instruction                                                                                   | Frank A. Moscatelli<br>Physics                | PHYS                       | \$30,964                | 8852201                 | 191         |
| Thiel Col<br>Greenville 16125<br>Molecular Physiology Equipment for Undergraduate Laboratories and Independent Study                                                                                 | Joyce M. Cuff<br>Biology                      | LIFE                       | \$7,387                 | 8851777                 | 125         |
| Univ of Pitt Bradford<br>Bradford 16701<br>Data Communications Laboratory                                                                                                                            | John C. Slimick<br>Computer Science           | COMP                       | \$17,328                | 8851834                 | 158         |
| Waynesburg Col<br>Waynesburg 15370<br>Improvement of Infrared Spectroscopy Laboratory Experiences                                                                                                    | Robert B. LaCount<br>Chemistry                | CHEM                       | \$17,987                | 8852592                 | 148         |



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| Wilkes Col<br>Wilkes-Barre 18766<br>Undergraduate Instruction for Testing Organics in the Environment                                              | Daniel Pindzola<br>Earth & Environ Scs               | OTH                | \$56,700        | 8852892         | 179  |
| <b>Rhode Island</b>                                                                                                                                |                                                      |                    |                 |                 |      |
| Roger Williams College<br>Bristol 02809<br>Digital Signal Processing Laboratory Enhancement                                                        | Rulph Chassaing<br>Electrical & Computer Engineering | ENGR               | \$26,950        | 8851147         | 173  |
| <b>Puerto Rico</b>                                                                                                                                 |                                                      |                    |                 |                 |      |
| Bayamon Tech Univ College<br>Bayamon 00620<br>Biomedical Instrumentation Laboratory                                                                | Deep Aggarwal<br>Electronics                         | ENGR               | \$12,300        | 8853274         | 173  |
| <b>South Carolina</b>                                                                                                                              |                                                      |                    |                 |                 |      |
| Furman Univ<br>Greenville 29613<br>Adding Fourth Generation Language and Real-time Concepts to an Introductory Computer Science Course             | Hayden S. Porter, Jr.<br>Computer Science            | COMP               | \$23,208        | 8851835         | 158  |
| Furman Univ<br>Greenville 29613<br>Equipment for a Modern Undergraduate Molecular Genetics Laboratory                                              | Laura K. Thompson<br>Biology                         | LIFE               | \$22,604        | 8851898         | 126  |
| Furman Univ<br>Greenville 29613<br>Instrumentation to Support Interdisciplinary Undergraduate Studies in Neurobiology                              | Gilbert W. Fairbanks<br>Biology                      | LIFE               | \$41,255        | 8853268         | 126  |
| Lander Col<br>Greenwood 29646<br>FT-IR for Enhanced Undergraduate Chemistry Instruction                                                            | Edward Stampf, Jr.<br>Science & Mathematics          | CHEM               | \$25,758        | 8851562         | 148  |
| Midlands Tech College<br>Columbia 29202<br>Integrated Process Control Laboratory.                                                                  | Hamed Javad<br>Elect/Electron Eng Tech               | ENGR               | \$31,540        | 8852456         | 173  |
| Tri-County Technical Col<br>Pendleton 29670<br>Automated Student Laboratory for Electronic Engineering Technology Curriculum                       | Floyd L. Wilcox, Sr.<br>Appl Microelect Ctr Innov    | ENGR               | \$98,759        | 8853149         | 173  |
| Univ SC Coastal Carolina<br>Conway 29526<br>Undergraduate Equipment for Applying Qualitative and Quantitative Analysis to Environmental Monitoring | Susan M. Libes<br>Marine Science                     | LIFE               | \$20,767        | 8852385         | 126  |
| <b>South Dakota</b>                                                                                                                                |                                                      |                    |                 |                 |      |
| Augustana Col<br>Sioux Falls 57197<br>Oxygen and Carbon Dioxide Analysis Systems to Enhance Laboratory Exercises in Whole Organism Biology         | Leland G. Johnson<br>Biology                         | LIFE               | \$19,400        | 8851188         | 127  |
| Augustana Col<br>Sioux Falls 57197<br>A Chromatography Module for the Chemistry Curriculum                                                         | Duane E. Weisshaar<br>Chemistry                      | CHEM               | \$15,765        | 8851195         | 148  |

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| Augustana Col<br>Sioux Falls 57197<br>Isotope Ratio Mass Spectrometry in the Undergraduate Biology Curriculum                                                                                       | Larry L. Tieszen<br>Biology                  | LIFE                       | \$39,215                | 8851442                 | 127         |
| Augustana Col<br>Sioux Falls 57197<br>Laboratory Development in Undergraduate Physics                                                                                                               | Karel V. Lugt<br>Physics                     | PHYS                       | \$13,630                | 8851445                 | 191         |
| <b>Tennessee</b>                                                                                                                                                                                    |                                              |                            |                         |                         |             |
| Austin Peay State Univ<br>Clarksville 37040<br>Integration of an Atomic Absorption Spectrophotometer into the Chemistry Curriculum                                                                  | Diane L. Simmons<br>Chemistry                | CHEM                       | \$11,423                | 8852900                 | 149         |
| Chattanooga St Tech CC<br>Chattanooga 37406<br>Computer Integrated Manufacturing                                                                                                                    | Wayne Jones<br>Engr Technology               | ENGR                       | \$88,200                | 8853340                 | 173         |
| Christian Brothers Col<br>Memphis 38104<br>Civil Engineering Water Resources Laboratory                                                                                                             | Steven S. Crider<br>Civil Engr               | ENGR                       | \$19,000                | 8853322                 | 173         |
| Rhodes College<br>Memphis 38112<br>Surface Reactions, Material Science, and Computer Controlled Instrumentation with Fourier Transform Infrared Spectroscopy in Undergraduate Instrumental Analysis | Kevin M. Ogle<br>Chemistry                   | CHEM                       | \$22,697                | 8851358                 | 149         |
| Roane State Community Col<br>Harriman 37748<br>Scanning Spectrophotometry in Organic Chemistry                                                                                                      | Irving T. Glover<br>Chemistry                | CHEM                       | \$5,332                 | 8852155                 | 149         |
| Univ of Tenn at Chatnga<br>Chattanooga 37402<br>Electrochemical Instrumentation for Undergraduate Instruction                                                                                       | Robert L. McNeely<br>Chemistry               | CHEM                       | \$8,140                 | 8853033                 | 149         |
| Univ of Tenn at Martin<br>Martin 38238<br>Undergraduate Instruction in Gas Chromatography/Mass Spectrometry                                                                                         | Charles E. Harding<br>Chemistry              | CHEM                       | \$26,283                | 8851275                 | 150         |
| <b>Texas</b>                                                                                                                                                                                        |                                              |                            |                         |                         |             |
| Amarillo Col<br>Amarillo 79178<br>Instrumentation and Laboratory Improvement in the Chemistry Department                                                                                            | Peggy Alley<br>Chemistry                     | CHEM                       | \$21,307                | 8852342                 | 150         |
| Bee County Col<br>Beeville 78102<br>Equipment for an Undergraduate Microbiology Laboratory.                                                                                                         | Michael T. Griffin<br>Biology                | LIFE                       | \$12,993                | 8851662                 | 127         |
| Houston Baptist Univ<br>Houston 77074<br>Use of Hands-On Nuclear Magnetic Resonance Spectroscopy to Strengthen the Organic Chemistry Laboratory Program                                             | Treacy L. Woods<br>Chemistry                 | CHEM                       | \$26,150                | 8851142                 | 150         |
| Southwest Texas St Univ<br>San Marcos 78666<br>Scientific Instruments for Undergraduates in Archaeology and Physical Anthropology                                                                   | Norman M. Whalen<br>Sociology & Anthropology | ANTH                       | \$9,684                 | 8852746                 | 196         |

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| St Mary's Univ S Antonio<br>San Antonio 78284<br>A Microcomputer Lab for a New Degree Program in Mathematical Science           | Stillman E. Sims<br>Mathematics                    | MATH               | \$45,448        | 8852311         | 183  |
| Texas A & I Univ<br>Kingsville 78363<br>Analysis of Natural and Synthetic Organic Mixtures in an Undergraduate Laboratory       | Ronald E. Marcotte<br>Chemistry                    | CHEM               | \$26,591        | 8851305         | 150  |
| Texas A & I Univ<br>Kingsville 78363<br>Calculus Enhancement Project                                                            | Dwight Goode<br>Mathematics                        | MATH               | \$19,213        | 8852083         | 183  |
| Texas Wesleyan Col<br>Fort Worth 76105<br>Computer-Interfaced Physiological Equipment for Undergraduate Instruction             | Donn D. Martin<br>Biology                          | LIFE               | \$28,220        | 8853346         | 128  |
| Trinity Univ<br>San Antonio 78284<br>Trace Elemental Analyses in Chemistry and Geology                                          | Michael P. Doyle<br>Department of Chemistry        | CHEM               | \$17,492        | 8851397         | 151  |
| U Tex San Antonio<br>San Antonio 78285<br>Integrated PC-Instrument Workstation Laboratory                                       | John L. Schmalzel<br>Div of Engr                   | ENGR               | \$79,065        | 8851970         | 174  |
| U Tex San Antonio<br>San Antonio 78285<br>Enhancement of the Teaching of Instrumental Methods through Fluorescence Spectroscopy | Dennis S. Rushforth<br>Div Earth & Phys Sci        | CHEM               | \$21,110        | 8852667         | 151  |
| U Tex San Antonio<br>San Antonio 78285<br>A Micro-computer Facility for Teaching Quantitative Methods in Structural Geology     | Alan P. Morris<br>Div of Earth & Physical Sciences | GEOL               | \$26,697        | 8853208         | 161  |
| U Tex San Antonio<br>San Antonio 78285<br>Digital Systems Design Workstations                                                   | Parimal A. Patel<br>Div of Engr                    | ENGR               | \$95,832        | 8853283         | 174  |
| <b>Virginia</b>                                                                                                                 |                                                    |                    |                 |                 |      |
| James Madison Univ<br>Harrisonburg 22807<br>Modernizing the Geography Laboratory Experience with ERDAS                          | Glen C. Gustafson<br>Geography                     | GEOG               | \$24,308        | 8851274         | 162  |
| James Madison Univ<br>Harrisonburg 22807<br>Computer Interfacing for Advanced Undergraduate Physics Laboratories                | Gerald R. Taylor, Jr.<br>Physics                   | PHYS               | \$11,600        | 8851396         | 191  |
| Mary Baldwin Col<br>Staunton 24401<br>Enhancement of the Curriculum through GC-MS                                               | Elizabeth M. Hairfield<br>Chemistry                | CHEM               | \$31,250        | 8851924         | 151  |
| Marymount College of Va<br>Arlington 22207<br>Computer-Interfaced Physiology Equipment for an Undergraduate Teaching Laboratory | Rosemary Hubbard<br>Science                        | LIFE               | \$11,407        | 8852723         | 128  |
| N Va Comm Col Alexandria<br>Alexandria 22311<br>Microcomputer as a Learning Tool in the Undergraduate Physics Laboratory        | Walter Wimbush<br>Natural Science and Mathematics  | PHYS               | \$10,780        | 8851740         | 191  |
| Radford University<br>Radford 24142<br>Fourier Transform Infrared Spectroscopy in the Undergraduate Laboratory                  | Billie J. Farrier<br>Chemistry                     | CHEM               | \$18,035        | 8851763         | 151  |

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| Sweet Briar Col<br>Sweet Briar 24595<br>Equipment for Undergraduate Plant Cell and Tissue Culture Laboratories            | Joanne Rosinski<br>Biology                     | LIFE               | \$8,400         | 8852144         | 128  |
| Va Military Inst<br>Lexington 24450<br>Fourier Transform Infrared for Chemistry                                           | Daniel Y. Pharr<br>Chemistry                   | CHEM               | \$10,650        | 8851885         | 152  |
| <b>Vermont</b>                                                                                                            |                                                |                    |                 |                 |      |
| Johnson St Col<br>Johnson 05656<br>A Computing Center for Undergraduate Science and Mathematics                           | Frederick M. Wiseman<br>Humanities/Environ Sci | OTH                | \$58,393        | 8853297         | 179  |
| Middlebury Col<br>Middlebury 05753<br>Nuclear Magnetic Resonance Instruction for Undergraduates                           | Jeffrey H. Byers<br>Chemistry                  | OTH                | \$81,000        | 8852661         | 179  |
| Norwich Univ<br>Northfield 05663<br>Environmental Monitoring Capability for Volatile Organic Compounds                    | Alan J. Fillip<br>Environmental Engr Tech      | ENGR               | \$17,867        | 8851451         | 175  |
| <b>Washington</b>                                                                                                         |                                                |                    |                 |                 |      |
| Central Washington Univ<br>Ellensburg 98926<br>An Integrated Approach to Microprocessor and Microcomputer Education       | Norman H. Wolford<br>Industrial & Engr Technol | ENGR               | \$49,889        | 8851476         | 175  |
| Eastern Washington Univ<br>Cheney 99004<br>Advanced Workstation Applications and Graphics Laboratory                      | Hugh D. Sullivan<br>Sch of Mathe Scs/Technol   | OTH                | \$66,348        | 8851382         | 179  |
| Evergreen State College<br>Olympia 98505<br>High Field Fourier Transform NMR in an Integrated Physical Science Curriculum | Neil E. Jacobsen<br>Chemistry                  | CHEM               | \$64,410        | 8852442         | 152  |
| Gonzaga Univ<br>Spokane 99258<br>Instrumentation for an Advanced Undergraduate Genetics Curriculum                        | Peter G. Pauw<br>Life Sciences                 | LIFE               | \$26,065        | 8851591         | 128  |
| Seattle Pacific Univ<br>Seattle 98119<br>Nuclear Magnetic Resonance Spectroscopy in Undergraduate Laboratories            | Lyle B. Peter<br>Chemistry                     | CHEM               | \$34,381        | 8852019         | 152  |
| Seattle Univ<br>Seattle 98122<br>Enhancing Laboratory Experiences in Wastewater and Hazardous Waste Treatment             | Rolf T. Skrinde<br>Civil Engineering           | ENGR               | \$13,410        | 8852097         | 175  |
| Seattle Univ<br>Seattle 98122<br>An Interdisciplinary Approach to Data Management in Undergraduate Instruction            | David C. Brubaker<br>Biology/Civil Engr        | OTH                | \$84,617        | 8852851         | 180  |
| Western Washington Univ<br>Bellingham 98225<br>Instrumentation for an Undergraduate Laser Spectroscopy Laboratory         | Richard Feinberg<br>Physics & Astronomy        | PHYS               | \$10,422        | 8851148         | 191  |
| Western Washington Univ<br>Bellingham 98225<br>Computer Support for Real-time Programming Instruction                     | Larry Menninga<br>Computer Science             | COMP               | \$16,165        | 8852080         | 159  |



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| Whitworth Col<br>Spokane 99251<br>Equipment to Improve Undergraduate Course Work and Independent Study in Biochemistry                                         | Donald F. Calbreath<br>Chemistry              | LIFE               | \$9,400         | 8851287         | 129  |
| <b>Wisconsin</b>                                                                                                                                               |                                               |                    |                 |                 |      |
| Beloit Col<br>Beloit 53511<br>Equipment for an Undergraduate Biotechnology Laboratory Program                                                                  | Alfred B. Ordman<br>Biochemistry              | LIFE               | \$78,097        | 8851464         | 129  |
| Beloit Col<br>Beloit 53511<br>Rock and Mineral Sample Preparation for Chemical and Microscopic Analysis                                                        | Richard C. Stenstrom<br>Geology               | GEOL               | \$20,650        | 8852835         | 162  |
| Lac Courtes Oreilles Ojibwa<br>Community College<br>Hayward 54843<br>Project CABLE (Chemistry and Biology Laboratory Education)                                | Ann M. Penzkover<br>Chemistry                 | CHEM               | \$5,125         | 8851410         | 180  |
| Lawrence Univ<br>Appleton 54912<br>Scientific Workstations in Undergraduate Physics                                                                            | David M. Cook<br>Physics                      | PHYS               | \$49,433        | 8851685         | 192  |
| Lawrence Univ<br>Appleton 54912<br>Algorithm Visualization Laboratory                                                                                          | Thomas L. Naps<br>Computer Science            | COMP               | \$35,043        | 8851781         | 159  |
| Lawrence Univ<br>Appleton 54912<br>Acquisition of a High-field Fourier Transform NMR Spectro-meter to Enhance Undergraduate Education in Chemical Spectroscopy | Jerrold P. Lokensgard<br>Chemistry            | CHEM               | \$95,250        | 8851800         | 152  |
| Ripon Col<br>Ripon 54971<br>Fourier Transform Infrared Spectroscopy in the Undergraduate Curriculum                                                            | Richard G. Scamehorn<br>Chemistry             | CHEM               | \$21,000        | 8851154         | 153  |
| Univ of Wis Eau Claire<br>Eau Claire 54701<br>Acquisition of an X-ray Diffractometer for Undergraduate Student Use                                             | Robert L. Hooper<br>Geology                   | GEOL               | \$45,958        | 8851615         | 162  |
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| Univ of Wis Parkside<br>Kenosha 53141<br>Microcomputer Networks/Operating Systems Laboratory                                                                   | Timothy V. Fossum<br>Applied Computer Science | COMP               | \$30,225        | 8852826         | 159  |
| Univ of Wis Platteville<br>Platteville 53818<br>Equipment Acquisition for Digital Control Laboratory                                                           | Piyare L. Sharma<br>Electrical Engineering    | ENGR               | \$26,000        | 8851439         | 176  |
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| Univ of Wis Platteville<br>Platteville 53818<br>Enhanced Computer Integrated Manufacturing Laboratory                                                          | Swaminathan Balachandran<br>Industrial Engr   | ENGR               | \$62,000        | 8851559         | 175  |

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| Wheeling Col<br>Wheeling 26003<br>Improving Data Acquisition and Analysis in the Undergraduate Biology Curriculum                              | Betty F. Thacker<br>Biology                     | LIFE                             | \$23,600                      | 8852741                       | 129         |

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Rebecca E. Payne, *Secretary*